RCRA FACILITY INVESTIGATION (RFI) WORK PLANS

OCCIDENTAL CHEMICAL CORPORATION

MUSCLE SHOALS, ALABAMA

PREPARED FOR

OCCIDENTAL CHEMICAL CORPORATION

NIAGARA FALLS, NEW YORK

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SECTION 1
INTRODUCTION

1.1 Overview. On May 6, 1991, the United States Environmental Protection Agency, Region IV (USEPA) contacted Occidental Chemical Corporation (OxyChem), see Exhibit 1-1, in connection with two former waste facilities (Waste Pile A and Waste Pile B) closed in 1986 at its chlor-alkali plant near Muscle Shoals, Colbert County, Alabama (see Figure 1-1 for Vicinity Map and Figure 1-2 for a site plan showing the locations of the former waste pile sites). The two former facilities were closed under 40 CFR Part 265. USEPA requested that OxyChem, in response to 40 CFR Part 270 post-closure care provisions, apply for post-closure permits for the two former waste piles, unless closure of the units could be demonstrated to be equivalent to clean closure under 40 CFR Part 264. OxyChem responded to USEPA that clean closure equivalency would be pursued for former Waste Pile A; this effort is currently underway. Former Waste Pile B, a concrete pad which had served as a staging area for precipitated brine mud and other process-related wastes, is underlain by groundwater impacted by mercury, cadmium, and chlorides, and, thus, a Part B permit for post-closure monitoring is required for this former facility. The primary reviewing authority for the post-closure permit application is the Alabama Department of Environmental Management (ADEM).

Since administration of Waste Pile B as a RCRA waste unit would eventually result in a RCRA Facility Assessment (RFA), OxyChem requested that the RFA be expedited so that the results could be considered in light of corrective action planning (in response to elevated levels of mercury, cadmium, and chloride previously detected in groundwater beneath a portion of the facility) and preparation of the Part B Permit application. The RFA was completed by USEPA's contractor, A.T. Kearney, in February 1992, based on a Preliminary Review (PR) and a Visual Site Inspection (VSI) of the Muscle Shoals facility conducted by Kearney's subcontractor K.W. Brown & Associates on December 12 and 13, 1991. The RFA report identified areas warranting further consideration and submittal of RCRA Facility Investigation (RFI) Work Plans.

1.2 RFA Report. The RFA report (Exhibit 1-2) identified a total of 25 solid waste management units (SWMUs), 4 areas of concern (AOCs), and one offsite area for the OxyChem Muscle Shoals facility; these are listed in Table 1-1 and are located on Figure 1-3. The report identified certain units and areas for which an RFI would be required; these are listed below and shown in greater detail on Figure 1-4 for units/areas inside the plant process area and Figure 1-5 for units/areas outside the central plant.

SWMU No.	AWMU/AOC Name
1	Closed Landfill
2	Former South Impounding Basin
3	Former North Impounding Basin
4	Former Salt Storage Piles
6	Former Sludge Pads (Precipitation Basins)
7	Mercury Cell Room Trench System
8	Former Hypalon-Lined Storage Tank
10	Mercury Collection Vessel
13	Scrubber Solution Treatment Tank
14	Industrial Sewer System
15	Old East Outfall Ditch
16	NPDES Outfall Ditch
23	Southern Stormwater Discharge Ditch
24	Stressed Vegetation Area South of Former South Impounding Basin
25	Former Waste Piles A and B
AOC	
A	Junkyard
B	Old TVA Pipeline Right-of-Way
C	Gravel Areas Adjacent to Electric Substation
D	Old East Ditch
Offsite	Pond Creek

In response to its review of the RFA report, OxyChem submitted a letter (Exhibit 1-3) to be included as an addendum to the report; the letter identified apparent misinterpretations or inconsistencies in the RFA report.

The initial response to the RFI requirement is the preparation of work plans for each unit and area, which evaluate whether sufficient information currently exists upon to assess potential environmental concerns or whether additional information is needed (e.g., sampling and analysis).

1.3 Interrelationship of the RFI Work Plans and the Part B Post-Closure Permit Application for Former Waste Pile B. A meeting attended by ADEM and (telephonically) USEPA was held at the OxyChem facility on November 5, 1991, to discuss the overlap of information and data required and to address the merits of submitting one multivolume document to meet the needs of the post-closure permit application for former Waste Pile B, the RFI Work Plans that would likely be required as a result of the RFA, and ADEM interests concerning corrective action at the facility. The interfacing of the documents was viewed as maximizing awareness of the environmental issues at the site and their interrelationship and minimizing paper costs and report production effort. A letter documenting the meeting and the agreement on a multivolume submittal is included as Exhibit 1-4.

Submitted concurrently with the RFI Work Plans document are the five volumes of the post-closure permit application. Information and data (e.g., boring logs, monitor well details, sampling records, analytical data) presented in the permit application are referenced, where appropriate, in the RFI Work Plans report. The post-closure permit application for former Waste Pile B consists of:

Volume I	Overview of Permit Application, Background Information, Site Description, and Groundwater Assessment and Conclusions
Volume II	Post-Closure Plan
Volume III	RCRA Groundwater Monitoring Section

Volume IV Alternate Concentration Limit (ACL) Demonstration

Volume V RCRA Corrective Action Section

Within the RFI Work Plans report, if, for example, reference is made to boring logs included in Appendix A of the permit application, the referencing format would be "... the logs of the borings are presented in Appendix A of Volume I...."

1.4 Organization of the RFI Work Plans Report. Section 2 contains a brief discussion of the OxyChem facility. Section 3 describes the field investigation (groundwater assessment) conducted over the past five years. Section 4 describes site conditions based on the groundwater assessment findings and characterizes the site-wide groundwater concerns. Section 5 includes the site assessment and Section 6 contains conclusions drawn from the site-wide groundwater assessment. Section 7 includes transition information to aid the review in applying the results of the site-wide assessment to the individual SWMUs and area RFI Work Plans. Sections 8 through 21 contain RFI Work Plans for the above mentioned SWMUs, AOCs, and Offsite Area and include (1) elements of the site-wide investigation pertinent to each unit or area and (2) the rationale for recommending (or not recommending) additional sampling and a plan for any proposed additional work.

SECTION 2
BACKGROUND

2.1 General. The OxyChem Muscle Shoals Chlor-Alkali plant was built for the United States government in 1953 by the Monsanto Corporation; sold to Diamond Shamrock Chemicals Company (Diamond Shamrock) in 1955; operated continuously; and sold to OxyChem in 1986. The plant produces chlorine, potassium hydroxide, potassium carbonate, hydrogen gas, and prior to 1992, caustic soda (sodium hydroxide).

2.2 Facility Location/Description. The OxyChem property occupies approximately 720 acres in the town of Muscle Shoals, Colbert County, Alabama. The plant is located approximately one mile south of the Tennessee River and 60 miles west of Huntsville, Alabama (at latitude 37 degrees, 46 minutes and 20 seconds and longitude 87 degrees, 37 minutes and 40 seconds). The vicinity map, Figure 1-1, shows the surrounding property use: industrial, agricultural, limited suburban, and rural.

The OxyChem production facility of approximately 50 acres is centered on the property, on which also are located a company owned golf course to the west, leased-out cotton fields to the south and southeast, and considerable undeveloped woodlands to the north and northeast. Access to the site is principally from the Wilson Dam Road (State Highway 133) to the west, although it is possible to gain entry via a service road to the east. A 1988 aerial photograph provided as Figure 2-1 shows the plant boundaries and surrounding property use.

Roads within the plant area are asphalt paved. Yard surface areas are either paved or gravel covered. The site plan, Figure 1-2, shows the plant features and the locations of groundwater observation wells.

2.3 Process Description. The OxyChem facility is a 400 ton/day chlorine production plant. The electrolytic process employed takes potassium chloride (KCl) as the raw material and produces chlorine gas (Cl_2), hydrogen gas (H_2) and potassium hydroxide (KOH). In a follow-on process, a portion of the KOH is converted to potassium carbonate (K_2CO_3) and a portion of the K_2CO_3 is converted to potassium bicarbonate ($KHCO_3$). A simplified chlor-alkali process flow diagram is shown on Figure 2-2. Figure 2-3 is a site plan of the process area showing product loading and unloading areas. The locations of the plant fire hydrants are also shown on Figure 2-3. The industrial sewer and plant stormwater system are outlined on Figure 2-4.

Non-naturally occurring chloride (Cl) and cadmium (Cd) at the OxyChem site are primarily attributable to nearly 40 years of uncovered surface storage of 8,000 to 12,000 tons of NaCl. Ongoing seepage and surface runoff have undoubtedly contributed to the chloride plume migration. Cd, while naturally occurring in the soil, is also a leachable trace element in salt and the various process filter carbons, most of which are stored in buildings or under cover in the process area. An exception to this is 17 tons per year of carbon for the Funda filters which are staged outside, one pallet at a time. There is also trace Cd present in the Na_2CO_3 (used in salt purification), which is stored in the chemical stock building. Mercury stocks are carefully maintained in the same building and losses during storage are unlikely.

The plant wastewater is primarily of significance as the principal source of mercury (Hg) and a contributing source of Cd. Mercury wastewaters are generated in the mercury cell from two sources: purging of water used as vapor seals on electrolytic cell endboxes, and wash downs of the cell building. Since 1974, these waste streams are routed to the facility wastewater treatment plant, directly or after temporary storage in a 500,000-gallon wastewater storage tank. Treated wastewaters are discharged via the industrial sewer system to the facility's NPDES ditch. They are routinely monitored for pH, chlorides and mercury according to the requirements of the facility's NPDES permit.

The evolution of the plant effluent water quality is thoroughly described in Volume IV (Alternate Concentration Limit Demonstration). Prior to the installation of the dimensionally stabilized anodes (1975), there was a problem with water building up in the closed brine process. The excess brine (80 to 85% saturated with salt and containing Hg and Cd) was discharged in a variety of ways but mostly in the low area south of the cell building.

Each constituent is found in various degrees in the plant solid wastes (clarifier backwash muds, saturator sludges, assorted carbon filter packs/cakes and industrial wastewater sump sludges). Solid wastes were landfilled on-site until off-site disposal began in February 1980. By 1980, the landfilled materials had been redistributed in place east of the plant and a clay cap was constructed.

Hg is also known to migrate in dusts and vapors to the plant surfaces. Additionally, salt dust settles in the storage area south of the cell building along with residues from the handling of the backwash muds and saturator sludges. During rainfall, some of the residues are carried away with the runoff. The plant surface flow control system has evolved to include the treatment of initial surface flow to address the situation.

Throughout the operational lifetime of the facility, waste management practices have significantly evolved from direct discharge of untreated facility wastewater to a three-step treatment process including carbon polishing prior to discharge through the facility NPDES ditch and from on-site disposal to shipment of all hazardous wastes to a RCRA permitted landfill facility. These improvements have essentially eliminated replenishing sources of contamination. Groundwater impacts are due to residual constituent concentrations.

2.4 Former Waste Pile B and Chemical and Physical Analyses of Wastes. Former Waste Pile B, a storage area for hazardous waste materials from 1980 to 1985, was a 12,000 ft^2 area, consisting of a 4-inch layer of shotcrete placed over 8 inches of reinforced concrete. The facility surface was sloped to divert rainwater to a sump, from which liquids were pumped to the wastewater treatment system. A 6-foot high wall was constructed at the rear of the area to prevent wind dispersal problems.

The storage pad was used to store hazardous waste in bulk and drums. The majority of hazardous wastes stored in this area were bulk sludges. The wastes stored in former Waste Pile B are listed below.

Waste Description	EPA ID NO.
Contaminated Equipment	D009
Cell Butter	D002, D009
Wastewater Tower Carbon	K106
NaOH Funda Filter Cake	D002, D009
KOH Funda Filter Cake	D002, D009
NaOH Adams Filter Cake	D002, D009
KOH Adams Filter Cake	D002, D009
Hydrogen Adsorber Carbon	D009
Wastewater Treatment Filter Cake	K106
Spent MEK, Paint Waste	F005
Wastewater Pit Sludge	K106
NaOH Saturator Sludge	K071
KOH Saturator Sludge	K071
NaOH Clarifier, Filter Backwash Sludge	K071
KOH Clarifier, Filter Backwash Sludge	K071

The amount of bulk waste in former Waste Pile B at any one time ranged from 0 to 400 tons. The waste was routinely removed by loading the waste into dump trucks or roll-off containers supplied by a waste disposal contractor for disposal at the Chemical Waste Management chemical waste disposal facility in Emelle, Alabama. Typically, 20- to 24-ton trucks or 12- to 19-ton roll-off containers were used.

Former Waste Pile B was closed in 1986, and the closure activities included the following:

- o Waste removal and disposition

- o Mechanical decontamination of the surface pad by blasting with water under at least 12,000 psi of pressure. During the washing process, the wash water was pumped to the NPDES permitted plant wastewater treatment system.

- o Sampling of the concrete liner and analysis of samples for mercury to demonstrate liner decontamination.

- o Coating with 4 to 6 inches of asphalt.

Acceptance of closure certification was granted by ADEM on June 2, 1986 and USEPA on September 19, 1986.

The area is currently used to store wastes contained in drums or covered roll-off containers. The sump remains in service for collection and transfer of rainwater.

Exhibits 2-1, 2-2, and 2-3 of Volume I include, respectively, (1) a description and classification of wastes stored in Waste Pile B, (2) Waste Characterization and Summary Sheet forms with attached analyses for the applicable wastes, and (3) the Waste Pile B 1985 Closure Plan and ADEM/USEPA Closure Certification letters.

2.5 Water Wells. Water wells in the vicinity are shown on Figure 2-5, well depth and use/status are indicated on Table 2-1. There are 83 reported water wells in a 3 mile square centered on the OxyChem plant property. The water wells are or were used for domestic, irrigation, and industrial purposes. The nearest drinking water well (No. 5 on Figure 2-5) is 800 feet east of the plant property, and is screened in the deep limestone formation (about 250 feet deep). The bulk of the populace in the area is on city water supplied from the Tennessee River.

2.6 Nearby Industries. There are four industries near the OxyChem plant (see Figure 1-1). Across Wilson Dam Road downgradient of the OxyChem plant to the west and northwest is the 2600-acre Tennessee Valley Authority (TVA) National Fertilizer Development Center. There are three CERCLA sites and one RCRA facility on the TVA property. TVA has a groundwater monitoring system for these areas. Groundwater monitoring data obtained from the Alabama Department of Environmental Management (ADEM) for the TVA wells indicate the primary constituents of concern to be nitrates, other nitrogen compounds and halogenated hydrocarbons. Analyses for chlorides, mercury and cadmium have shown no instances of values above minimum water quality standards.

About two miles upgradient and east of the OxyChem plant are the U.S. Diecasting plant (formerly Ford) and the Reynolds Metals plant. Review of groundwater data for the closer plant, U.S. Diecasting, revealed the constituents of concern to be chlorinated hydrocarbons (e.g. trans 1,2-dichloroethene at values as high as 775 μg/l downgradient and west of the U.S. Diecasting plant). There was no information on mercury, cadmium or chlorides. Groundwater data for the Reynolds plant indicated concern for organic process materials. Chloride analyses reflected background levels for Colbert County, and there were no analyses for mercury or cadmium.

On the eastern boundary of OxyChem is the Harcros Company, a small facility for packaging chlorine purchased from OxyChem. There is no known groundwater problem associated with this facility.

2.7 Climate and Setting. The Muscle Shoals area has a mild, humid climate. The average annual precipitation and temperature, as measured at the Muscle Shoals Airport (approximately 2 miles from the Oxychem plant), are 51.58 inches and 60.8^{o}F, respectively. A wind rose for the Muscle Shoals area (Huntsville, Alabama airport) is shown on Figure 2-6 and indicates a predominant southeast to northwest wind direction. The site topography is characterized as gently rolling. The plant topographic map, presented as Figure 2-7, shows elevations across the site ranging from a high of 540 feet

MSL (south and west of the plant) to a low of 518 feet along the drainage feature which traverses the property from southeast to northwest.

2.8 Regional Geology. The geology of the area is dominated by a limestone rock sequence of Paleozoic age (Mississippian). The uppermost formations include the younger Tuscumbia Limestone overlying the Fort Payne Chert. No significant tectonic forces have been exerted in the region; however, a widely known regional structure, the Nashville Dome, has resulted in a 20 foot per mile dip to the south and southwest. The regional geology is shown on Figure 2-8. Details on the regional stratigraphy, presented below, were extracted from a 1963 Geological Survey of Alabama publication (Harris et al) which was endorsed by a 1987 U.S. Geologic Survey report (Bossong and Harris) as still being current. The area exhibits an active Karst topography and numerous relic sinkholes are visible from the air and by inspection of topographic maps.

Tuscumbia Limestone. The Tuscumbia limestone is a light gray, medium bedded, hard, dense, finely crystalline limestone. It contains considerable quantities of chert as nodules and thick lenses and a few thin beds of greenish gray shale. The Tuscumbia locally reaches a maximum thickness of about 200 feet in southern Colbert County; however, near the site, the upper part of the formation has been weathered to clay and less than 100 feet of intact limestone remains.

Regolith. The Tuscumbia limestone is covered by an unconsolidated mantle of residual soil and rock debris, alluvial soils, colluvium, and terrace deposits. The residual soils consist principally of unstratified clay that includes varying amounts of chert fragments. The alluvial terrace deposits and colluvium are also principally clay although the terrace deposits contain lenses and beds of sand and gravel. Owing to the presence of beds and lenses of sand and gravel, the permeability of the regolith is quite variable. The regolith varies considerably in thickness with the thinner deposits in the stream valleys, and the thickest deposits on ridge tops (Figure 2-9).

In the vicinity of the OxyChem plant the depth of unconsolidated material encountered ranges from 45 to 90 feet.

Surficial Soils. The principal soils present in the area are the Dewey, Abernathy and Guthrie series. The predominant soils are the Dewey series which are derived from the weathered limestones of the Tuscumbia formation. The Dewey soils are characterized by a reddish brown, mottled yellow and gray clay, with an increasing amount of chert fragments with depth. It is a sticky clay and may also contain iron or manganese concretions.

The Abernathy soils are typically found in swales, sinks or saucer like depressions in the Dewey soils. The Abernathy is a light gray, mottled rust brown and yellowish gray clay or silty clay. It becomes sticky when wet and may have poor drainage, depending on the size of the area.

The Guthrie soils occupy basins and swales with little or no surface outlet, giving rise to semi-swampy areas with standing water existing during the winter and spring months. It is a poorly drained soil and is usually a blue gray, tough mottled gray and brown clay.

2.9 Site History. Prior to 1952, the site was under cultivation except for the low areas which were forested with oak, poplar, and gum. Beginning in 1952 and finishing in 1953, the Monsanto Corporation built the Muscle Shoals chlor-alkali plant for the United States Government according to U.S. Army Corps of Engineer approved plans. Subsequent to start-up and acceptance, the government deactivated the facility and put it on the public market. The Diamond Shamrock Corporation purchased the plant and began private operation on March 1, 1955. The chlor-alkali process, which has remained essentially unchanged, involves the electrolytic decomposition of brine (water saturated with salt) in an electrolytic cell in which liquid mercury serves as the cathode and carbon as the anode. The products of the electrolysis and the attendant decomposer step are chlorine gas, hydrogen gas and, beginning in 1963, potassium hydroxide (KOH), when KCl was included as a raw material. The use of NaCl as a raw material and the production of sodium hydroxide was discontinued in 1991. The only changes in raw materials and products since the plant began operations in 1955 include: (1) the addition of the KOH variation in 1963; (2) the start-up in 1965 of a process to convert KOH to K_2CO_3; and (3) the elimination of NaCL as a raw material and sodium hydroxide as a product in 1991. Improvements in power distribution and mercury cell construction did, however, result in the growth of plant capacity from an original 150 ton/day chlorine gas production to a current capacity on the order of 400 ton/day.

2.10 Previous Investigations. The RFI Work Plans presented in Sections 8 through 22 are principally based on an extensive site investigation initiated by OxyChem in December 1987 as the result of purchasing the facility from Diamond Shamrock (currently the Maxus Corporation). OxyChem retained G&E Engineering, Inc. (G&E) to conduct the investigation which has included developing an array of 64 observation wells, conducting 22 soil and/or groundwater sampling events, and producing two major reports:

- Groundwater Assessment of the Muscle Shoals Facility, G&E Engineering, Inc., May 1989 (six volumes)

- Supplemental Report of Groundwater Assessment of the Muscle Shoals Facility, G&E Engineering, Inc., July 1991 (two volumes)

These and several earlier investigations, which were conducted between 1979 and 1987, are summarized in Table 2-2. Where appropriate, data from the previous investigations have been incorporated in this application.

Brief descriptions of the earlier investigations are presented below. Reference can be made to Figure 1-2 for the locations of observation wells and site features.

White Engineering, Inc. (1979). Diamond Shamrock Corporation closed their landfill (primarily used for the disposal of clarifier backwash muds of precipitated calcium carbonate [$CaCO_3$] and calcium sulphate [$CaSO_4$]) and physically separated a large bermed low area referred to as the North Impounding Basin (temporarily used in 1970-71 for containment of surface runoff and plant discharges). White Engineering was retained to design the surface flow control system which would separate the North Impounding Basin from the industrial sewer and surface runoff flows, and to prepare plans for a clay cap for the landfill. Construction took place from late 1979 to early 1980. No soil borings or observation wells were installed by White Engineering.

Woodward-Clyde Consultants, Inc. (1980). To comply with a February, 1980 letter from the Alabama Department of Public Health, Diamond Shamrock contracted with Woodward-Clyde Consultants (WCC) to establish site groundwater flow patterns and to install a minimum of four observation wells to monitor possible impact by the former landfill on Pond Creek and subsequently the Tennessee River. In May and June of 1980, eighteen borings were completed as piezometers in an effort to describe the soils, stratigraphy and groundwater regime within the area surrounding the North Impounding Basin and landfill. A July report described the soil and groundwater of the site. In August, nine additional piezometers (P-19 through P-27) were installed. Seven were in or on the edge of the landfill with three of these penetrating the underlying limestone. No report exists to explain the purpose of these additional piezometers, but considering when they were installed they were most likely used to describe landfill conditions and help in the decision of where to locate the observation wells requested by ADEM. Four observation wells (OW-1 through OW-4) were installed in September, 1980.

Woodward-Clyde Consultants, Inc. (1980). In November, 1980 WCC installed nineteen borings through the cap of the landfill to establish cap thickness and to obtain samples for laboratory permeability analyses. Fourteen field constant-head permeability tests were also performed on the clay cap material. The cap was found to vary in depth from 1.7 to 10.2 feet, with the western to southwestern portion of the landfill having an average cap thickness of 2 to 3 feet and the balance of the landfill being capped by in excess of three feet of clayey soil. Laboratory permeability values ranged from 1.0×10^{-5} to 4.7×10^{-7} cm/sec. Field permeability values ranged from 7.4×10^{-6} to 5.6×10^{-7} cm/sec.

Woodward-Clyde Consultants, Inc. (1981). From September 1980 to April 1981, WCC conducted a surface sampling program of the sediments throughout the former North Impounding Basin. In total, 107 samples from 58 locations were analyzed. Only three samples showed mercury concentrations in excess of 2 μg/l; the concentrations were 5.7, 3.8 and 2.3 μg/l respectively. Based on these findings there was a September, 1981 ruling from the Alabama Department of Public Health that the former North Impounding Basin posed no harm to the environment.

Woodward-Clyde Consultants, Inc. (1981). In February and March 1981, WCC installed twenty-one additional observation wells, OW-5 through OW-24 (including OW-15A and OW-15B). This was an expansion of the original scope of work and represented attempts to define the limestone groundwater regime and to establish the extent, if any, of contamination from the landfill. No formal reports or records other than well profiles and a few unsubstantiated sampling records were found for these wells.

Dames And Moore, Inc. (1987). In January and February 1987, Dames and Moore was retained to locate and evaluate the condition of the WCC observation wells and piezometers; measure water levels; obtain groundwater samples for evaluation by OxyChem; evaluate the condition of the landfill; and comment on the landfill's possible role as a contamination source. Many of the wells and piezometers were found by Dames and Moore to be of poor construction and their abandonment recommended. Of the 25 observation wells, 4 had elevated Hg concentrations (as high as 125 μg/l) and 9 had elevated Cl values (as high as 12,730 mg/l). However, given the physical condition of some of the wells, especially the lack of sealing grout above the well screens, the values were considered inconclusive by Dames and Moore. Dames and Moore concluded that there was insufficient information upon which to comment on the landfill's role as a source. The landfill cover was believed to be in reasonable condition. The recommendations of the Dames and Moore report served as the initial scope of work for the groundwater assessment conducted by G&E and described in this report.

Appendix A of Volume I includes boring logs for the above described earlier borings and piezometers.

SECTION 3
FIELD INVESTIGATION

3.1 General. The groundwater assessment conducted between December 1987 and May 1992 included (1) inspection and closure or upgrading of pre-1987 piezometers and observation wells; (2) conducting a geophysical survey using electromagnetic conductivity instruments; (3) drilling and sampling soil exploration borings (with geotechnical testing of selected soil samples); (4) completion of soil exploration borings as groundwater observation wells; (5) hydraulic conductivity testing of observation wells; (6) water level measurements; (7) groundwater sampling and analyses; (8) sampling and analyses of soil, groundwater, surface water and sediment from several special interest areas; (9) and dye-tracing study. The reference material for the field investigation discussion is contained in Volumes I and III of the Part B Post-Closure Permit Application for former Waste Pile B:

- Volume I, Appendix A - Boring Logs (G&E and earlier studies)
- Volume I, Appendix B - In-situ Hydraulic Conductivity Tests
- Volume I, Appendix C - Observation Well Sampling Records
- Volume I, Appendix D - Field Investigation Protocols
- Volume I, Appendix E - Laboratory Analytical Data
- Volume III, Appendix A - Observation Well Cross Sections

3.2 Geophysical Conductivity Survey. Geophysical surveys were conducted by G&E during two field events (December 1987 and February/March 1988). The surveys were conducted with two conductivity (electromagnetic) instruments - the Geonics EM-31 and

EM-34. These instruments measure the presence of ionic mobility constituents in soils and groundwater. These measurements are useful when comparing anomalous data against normal or background data verified by intrusive sampling and analysis. Significant deviations from measured background levels indicate the possible influence of high conductivity constituents such as salts, polar organics, and metal objects. At the OxyChem facility, the geophysical survey was directed at delineating the extent of salt migration.

The EM-31 instrument is a continuous reading device which measures conductivity (mmhos/m) to a depth of 6 meters. The EM-34 instrument is a discrete measurement device, which, depending on configuration, measures average conductivity responses at 3 different depths - 10 meters, 20 meters, and 40 meters.

Referring to Figure 3-1, the December 1987 surveys were conducted across the closed landfill area; in the area of stressed vegetation southwest of the Former South Impounding Basin; and in a swampy area south of the plant headquarters building. The February/ March 1988 geophysical surveys were conducted in the Former North Impounding Basin area (both east and west of the existing north-south road); in the area east and north of the Closed Landfill; and in the vicinity of the Former South Impounding Basin. Where possible, the conductivity surveys encompassed background levels in areas where there were no plant activities. Readings were typically taken from background areas toward areas of suspected concern and continued until background readings were again reached or approached. The description of the geophysical survey activities and the results of the survey findings in each area of study are presented in the following subsections. Geophysical response measurements for each depth plotted and the contours derived from these measurements are shown on Figures 3-2 through 3-5 for sounding depths of 6, 10, 20 and 40 meters, respectively. Background conductivity values were interpreted to be 20 mmhos/m or less.

3.2.1 Closed Landfill Conductivity Findings. The Closed Landfill area and areas to the east, west and north of the landfill were surveyed in an east-west direction on a 100 foot grid with some transecting north-south lines. Approximately 2.4 miles of geophysical survey was accomplished at sounding depths of 6, 10, 20, and 40 meters. Geophysical response measurements at all depths indicated areas of high ionic concentration within the landfill area (see Figures 3-2 through 3-5). These levels extended a limited distance past the physical limits of the capped portion of the landfill.

It was possible to reach a background measurement on all but the northerly boundary of the Closed Landfill, which abuts the southeastern portion of the Former North Impoundment Basin. The former plant wastewater discharge pipe to the former basin is also in this area.

There are some areas of particularly high conductivity readings (greater than 300 mmhos/m) in the Closed Landfill which are indicative of high ionic mobility constituents and/or the presence of metallic objects.

Figures 3-2 through 3-5 show that the horizontal extent and magnitude of conductivity readings generally decreased with depth, although some anomalously high measurements were obtained at increased depths. These deeper anomalies typically underlay shallower anomalous areas and there may be some "masking" by shallow highly conductive materials.

Conductivity measurements in the former stressed vegetation area north and east of the landfill were elevated only to a depth of 10 meters, dropping off sharply at greater sounding depths.

3.2.2 Former North Impounding Basin Conductivity Findings. In the Former North Impounding Basin, approximately 3.9 miles of geophysical grid lines were surveyed in the areas east and west of the north-south access road (see Figure 3-1).

Much of this area was covered with water as deep as two feet at the time of the survey. The survey was conducted at all instrument reading depths (EM-31 and EM-34) and grid locations on the eastern half of the basin. In the western half of the basin (west of the north-south road), the EM-31 survey was conducted at all grid locations; the EM-34 was used at all grid nodes for the 10 meter survey, and at selected grid nodes for the 20- and 40-meter sounding depths.

The geophysical survey measurements in the Former North Impounding Basin were noticeably lower than those measured in the landfill area (see Figures 3-2 through 3-5). The conductivity readings were highest in the eastern end of the former basin. This is attributed to the location of the former plant industrial wastewater outfall and the eddy pattern created by the outfall.

With one exception, the remaining portion of the eastern half of the basin and all of the western half of the basin indicated background or low conductivity readings for all depths. The exception was a limited anomalous reading in the southwestern corner of the western half of the basin where values higher than 300 mmhos/m were measured. There was no apparent visible indication of stressed vegetation or external influence in this area.

3.2.3 Former South Impounding Basin Conductivity Findings. EM-31 and EM-34 surveys were conducted over approximately 2.5 miles of geophysical grid system (see Figure 3-1) in the vicinity of the Former South Impounding Basin. The survey data indicate a correlation between the stressed vegetation pattern and elevated conductivity readings. The conductivity values are highest (on the order of 200 mmhos/m) in the immediate vicinity of the Former South Impounding Basin.

Conductivity values decrease with distance from the boundary of the former basin and stressed vegetation area (see Figures 3-2 through 3-5).

The variation in conductivity values with depth was distinctly different from that observed in the closed landfill and former north impounding basin areas. The data indicate that the anomalous conductivity measurements are at their highest, and have the greatest horizontal extent, at the 20 meter depth. The pattern of migration suggests that high conductivity constituents may have migrated vertically to a depth of 20 meters, where the limestone formation is normally encountered, and moved horizontally at this horizon. The forty meter depth measurements indicate a reduction from the 20 meter readings; however, these readings are higher than measurements at 6 and 10 meters.

Background measurements, and thus inferred lateral limits of possible impact, were established at all geophysical survey depths. The elevated conductivity values at lower depths may be influenced by the presence of higher ionic conductivity constituents at shallower depths (masking effect).

3.3 Soil Exploration Borings. Forty-two truck-mounted exploration borings were advanced to (1) define the subsurface geology, (2) provide samples for determining horizontal and vertical extent of constituent migration, and (3) in most cases, be completed as observation wells. Boring locations were selected by interpreting current and past plant processes, the geophysical survey data, other site features (e.g., topography and drainage features), and in support of source removal efforts (e.g., deactivation of the KCl and NaCl brine precipitation basins). The boring locations are indicated on Figure 3-6.

Soil samples were taken on five-foot centers, or change of strata down to the limestone bedrock. The soil samples were extruded and retained for geotechnical and analytical analyses. For those borings which encountered limestone, a carbon steel 6-inch casing was placed in the boring and driven down to the required depth to prevent sediments and rock fragments from falling into the borehole while coring the underlying limestone. Diamond bit core barrels were used for drilling through the limestone and chert. Limestone cores were retrieved for core characterization purposes and assessment of fracturing, solution openings, etc. Upon completion of the soil exploration borings, the open holes were either completed as Lower Zone observation wells (well screens set in the upper four to five feet of the limestone bedrock), Deep Zone observation wells, or were plugged and abandoned with a cement-bentonite grout. Boring logs are provided at Appendix A of Volume I.

3.4 Geotechnical Laboratory Testing. Atterberg limits, moisture content, and dry density were determined for selected soil samples to confirm soil classifications. Additionally, vertical hydraulic conductivity permeameter tests were conducted on selected clayey samples. Geotechnical analyses were conducted by G&E Engineering or Eustis Engineering, and the results are shown on the boring logs in Appendix A of Volume I and/or on Table 3-1.

3.5 Soil Analytical Testing. At the beginning of the investigation, soil samples were analyzed for total Hg and Cl to determine the horizontal and vertical extent of constituent migration. As the investigation progressed, (1) the presence of Cd as a constituent of concern was established and (2) the significance of extractable (mobile) versus total concentrations became apparent. As a result, borings B-35, B-36, B-37, B-40, B-41, and B-42 included analysis for total and extractable Hg and Cd. Total Hg values ranged from <0.004 to 200 mg/kg, Cl from 5 to 43,500 mg/kg, and Cd from 1.7 to 5.7 mg/kg. Extractable Hg values ranged from <0.0002 to 0.219 mg/l and Cd from <0.0001 to 0.0039 mg/l. The data for the total Hg and Cl are shown, along with west to east cross sections, on Figure 3-7 for the borings outside of the central plant area and Figure 3-8 for those inside the central plant area. Table 3-2 presents the results of the total and extractable data for those borings where both analytical methods were utilized. Table 3-3 provides the total Hg and Cd analysis of background soil (a composite from borings B-38 and B-39) utilized in the laboratory adsorption/desorption studies discussed in Volume IV of the permit application. Of significance was the detection of Cd in background soil at levels in excess of 3,000 μg/kg. A cadmium level of this magnitude in the site soil represents the most likely source for the levels of Cd observed in the groundwater. Analytical reports are contained in Appendix E of Volume I.

3.6 Observation Well Installation. Eight of the original monitor wells (1980) were pulled and grouted and replaced by new observation wells designated with an "A" suffix. Well OW-15A was installed in 1980 and had an "A" suffix because a companion shallow well, OW-15B, was also installed at that time. In addition to the 8 replacement wells, 41 new observation wells were subsequently installed, making a total of 64 observation wells on the OxyChem property (see Figure 1-2). Observation well OW-43, originally adjacent to the closed landfill, was pulled and grouted in 1990 to accommodate the landfill upgrade construction.

An Upper Zone observation well (OW-2, OW-4 and all odd numbered wells) is defined as an observation well screened in the upper and middle residuum (unconsolidated soils). Lower Zone observation wells (even numbered wells, with the exception of OW-2 and OW-4) are those screened at the base of the residuum and in the top portion of the limestone bedrock. Deep Zone (DOW-series) observation wells are screened down within the limestone formation. Of the 64 observation wells, 32 monitor the Upper Zone, 26 monitor the Lower Zone, and 6 the Deep Zone. Wells were constructed of two-inch diameter PVC casing with varying screen length. Table 3-4 summarizes the observation well depths, screen intervals, surface elevation, top of casing elevations, and hydraulic conductivities derived from in-situ slug tests (see Section 3.7).

The construction details for the observation wells generally included sand packing around the screen, a minimum two-foot thick bentonite or sugar sand seal above the sand packing, and a thick cement-bentonite grout from the bentonite/sugar sand seal to the ground surface. Sugar sand was generally used in the deeper wells where placement of an adequate bentonite pellet seal was questionable. In four instances, packer seals, in lieu of a bentonite or sugar sand seal, were installed above the sand pack. Wells which penetrated limestone were installed using temporary or permanent outer casing around the riser pipe, sealed at the limestone surface. Depending on the well location, an above-ground lockable steel well shroud or a flush-mounted well head cover with a locking cap was installed over the observation well. A three-foot by three-foot concrete pad, four inches thick, was placed around the well shroud. A pre-numbered well seal was affixed to secure each well shroud and the seal number recorded on a well entry log for well entry/sampling documentation. The construction details for currently active observation wells are presented in Appendix A of Volume III.

3.7 Hydraulic Conductivity Testing. In-situ hydraulic conductivity tests were performed in all observation wells. The tests were conducted using an in-situ "Hermit" instrument, which consists of a pressure transducer and a data logger. The test determines hydraulic conductivity in the horizontal direction of the soils surrounding the observation well screen. Hydraulic conductivities were calculated using the Hvorslev (1951) method, with values ranging from 6.5×10^{-6} to 6.4×10^{-3} cm/sec. Calculations for each observation well are provided in Appendix B of Volume I. The hydraulic conductivity for each well is presented in Table 3-4.

3.8 Water Level Measurements. Eleven site-wide water level measurement events were conducted between December 1987 and January 1992. Potentiometric contour plots (May, July, and October 1988, and January 1989) for the Upper Zone and Lower Zone are shown on Figures 3-9 and 3-10, respectively, to provide a seasonal perspective of water level elevations. Potentiometric plots for the April 1992 groundwater monitoring event for the Upper Zone, Lower Zone, and Deep Zone are provided as Figures 3-11, 3-12, and 3-13, respectively. Table 3-5 provides the water level measurements for selected wells for the period January 1987 through April 1992 as a means of providing an extended indication of water level fluctuations. Also shown on Table 3-5 are 30-year averaged monthly rainfall values for use in relating groundwater level fluctuations with the typical rainfall pattern. Water level measurements for all wells for the period May 1989 through April 1992 are presented in Table 3-6.

3.9 Groundwater Sample Collection and Analyses. Twenty-two groundwater sampling events have been conducted. Temperature and pH measurements for each sampling event are documented on sampling records included in Appendix C of Volume I. Typical values have ranged between 4.5 and 7.0 in pH and 16.0 to 21.0°C in temperature.

In October 1988, two wells (OW-14A [near the Closed Landfill] and OW-27 [immediately downgradient of the Former South Impounding Basin]) were analyzed according to EPA Appendix IX procedures due to their locations and history of Hg and Cl concentrations. Table 3-7 provides the results of the analyses compared to drinking water standards, if established. In addition to Hg and Cl, cadmium (Cd) was observed in the water sample from well OW-27 at a level of 190 μg/l, exceeding the 1988 drinking water standard of 10 μg/l. All acid extractable compounds, base neutral compounds, pesticide and PCB compounds, chlorinated herbicide compounds, dioxin and furan compounds, and volatile organic compounds were found to be below detectable limits.

Prior to the October 1988 Appendix IX analyses, groundwater samples had been analyzed for Hg and Cl. Subsequently, Cd testing was also performed on selected wells, primarily those located in the plant process area. The results of Hg, Cd, and Cl analyses are summarized in Tables 3-8, 3-9, and Table 3-10, respectively. Based on the analytical results over the past five years, Hg values have ranged from <0.2 to 443 μg/l; Cd from <5 to 330 μg/l; and Cl values from <1 to 170,000 mg/l. Copies of the analytical laboratory reports are contained in Appendix E, of Volume I.

For most of the investigation, groundwater samples were analyzed after filtration. In January 1992, instructions were received from the USEPA to base interpretations on total (unfiltered) analyses. Accordingly, subsequent analyses have been (principally the site-wide event of April 1992) and will be conducted on unfiltered samples. Generally, the data of Tables 3-8 through 3-10 show that the filtered and total analyses are in reasonable agreement. To assist in visualizing constituent distribution, the data from the April 1992 sampling event has been plotted and isopleths drawn. Upper Zone and Lower Zone Hg isopleths are presented on Figures 3-14 and 3-15; Upper Zone and Lower Zone Cd isopleths are presented on Figures 3-16 and 3-17; and Upper Zone and Lower Zone Cl contours are shown on Figures 3-18 and 3-19.

3.10 Miscellaneous Sampling. During the initial field work, a number of additional areas were investigated (see Figure 3-20). Sampling included eight surficial soil samples (SS-1 to SS-8) and three surface water samples (SW-3, SW-5, and SW-7) taken from the low area southwest of the Former South Impounding Basin (previously showing stressed vegetation); two surficial samples (SS-9 and SS-10) and two surface water samples (SW-9 and SW-10) collected from the Old East Ditch (northeast of plant area) and three surface water samples (SW-11, SW-12, and SW-13) collected from the NPDES Outfall Ditch (Pond Creek Ditch). The analytical data for these samples are provided in Appendix E of Volume I and summarized on Table 3-11.

3.11 Dye Tracer Study. A dye tracing study was conducted to further assess the hydrogeology of the Deep Zone beneath the OxyChem facility with regard to transport direction and flow velocity. For a detailed discussion of the study, refer to the supplemental Groundwater Assessment Report (July 1991).

The dye tracing study (dye injected in Deep Zone wells DOW-2 and DOW-5) confirms a hydraulic connection between the Deep Zone beneath the site and Tuscumbia Springs (see Vicinity Map, Figure 1-1) to the southwest. Similar studies performed at the nearby U.S. Die Casting plant (former Ford plant) also indicated a connection between that site and the Tuscumbia Springs. However, it is important to note that no significant connection has been found between the Lower Zone and the Deep Zone at the OxyChem site, for the principal constituents of concern (Hg and Cd), i.e., the water quality in the deep zone for Hg, Cd meets drinking water standards in the centroid of the plume area (DOW-1) and in the downgradient direction (DOW-4, DOW-5, and DOW-6).

Historical water quality data and discharge rates of Tuscumbia Springs beginning in 1929 are presented in Table 3-12. Regional groundwater quality data for the Tuscumbia limestone is provided in Table 3-13. The detected concentrations of Hg, Cd, and Cl at Tuscumbia Springs have been either non-detectable or well below the drinking water standards established by USEPA/ADEM.

SECTION 4
SITE CHARACTERISTICS

4.1 Site Topography and Geology. The plant is situated on a local plateau with an approximate elevation of 540 feet MSL. The 1988 topographic map of the plant drawn on one-foot contours (Figure 2-7) indicates that the land slopes gently away from the plant in all directions with the exception of a small ridge that extends from the southeast corner of the plant in a southeasterly direction. There are other localized areas of higher elevations southwest of the plant. Harris et al (1963) reported that the topography in the general vicinity of the site is gently rolling, with relief resulting largely from solution activity in the underlying limestone rather than surface erosional effects. The most prominent topographic features of the general vicinity are sinkholes formed by solution and weathering processes. Regionally the sinkholes are oriented from southeast to northwest, paralleling the general groundwater flow toward the Tennessee River. Prevailing sinkhole orientation is generally indicative of the pervasive geologic structure (jointing).

The geology of the site, as determined by 42 soil exploration borings ranging in depth from 15 to 150 feet, is consistent with the regional description. Additional geological insights were gained from the non-intrusive geophysical investigation undertaken as part of the chloride plume mapping effort (see Section 3.2). Appendix A of Volume I contains the boring logs for all borehole explorations, and Figure 3-6 locates the borings. The soils (regolith or residuum) consist of silty clay (CL) and clay (CH) to depths of 8 to 37 feet. This is underlain by silty clay (CL) or clay (CH), with increasing amounts of chert fragments, and chert gravel layers to depths of 45 to 90 feet where the Tuscumbia limestone is encountered. Clay thickness isopachs are shown on Figure 4-1. These soils are generally reddish brown and typically contain oxides of iron and manganese. Subsurface fence diagrams representative of site subsurface conditions are presented on Figure 4-2 (east to west) and Figure 4-3 (north to south). The soil exploration borings of this report plus records of additional Woodward Clyde borings were utilized in preparing the limestone elevation map which is provided as Figure 4-4. The location of fractured bedrock, based on intrusive borings and the non-intrusive geophysical survey described in Section 3.2, are shown on Figure 4-5.

The most significant findings attributable to the geologic investigation are:

- o The sequence of silty clay, clay, chert, and limestone conforms with the regional descriptions of Harris et al.

- o The regolith, or residuum, depths conform to the regional values shown on Figure 2-8.

- o There is an area in the north and northeast portion of the plant, comprising the surface depression occupied by Pond Creek and the former North Impounding Basin, where borings encountered chert and limestone rubble above or within the limestone, followed by fractures and voids as the corings advanced into the limestone. This zone evidently represents a karstic dissolution and collapse zone within the limestone where groundwater flows preferentially through channels within the limestone matrix.

- o There is a distinct, circular depression of the surface soils (indicative of a possible sinkhole) in the vicinity of well cluster OW-25/OW-26.

4.2 Site Drainage. The site drainage is principally governed by the topography with the exception of the central plant area. In this area, ditches have been created which ultimately channel the surface flows to a sump in the plant's southeast corner where the initial flow of each storm is treated for the removal of mercury and salt residues. The surface drainage patterns are shown on Figure 4-6.

Figure 4-7 is a map of the facility and surrounding area delineating the 100-year flood plain. The 100-year flood plain area is based on the Flood Insurance Rate map for the City of Muscle Shoals, Colbert County, Alabama dated December 15, 1977. The 100-year flood elevation for this area is set at 523 feet (MSL). The process area, including former Waste Pile B, is not located within the 100-year flood plain.

4.3 Site Groundwater Hydrology. As shown on Figure 4-8 regional groundwater movement is west and north toward the Tennessee River with localized variations as the groundwater surface mimics the rolling terrain. A series of springs exist downgradient of the OxyChem site and along the river; the most notable is Tuscumbia Springs. At the plant site, information on the vertical and horizontal movement of groundwater was derived from water levels and in-situ hydraulic conductivity tests conducted in the 64 observation wells. Groundwater conditions are described below in terms of the Upper Zone, Lower Zone, and Deep Zone (a simplified hydrogeologic profile is provided as Figure 4-9).

4.3.1 Upper Zone. Groundwater elevations in the clayey regolith stratum (residuum) tend to conform to surface contours. An exception to this is the mounding of groundwater beneath the plant proper, which is attributable to the presence of a nearly continuously charged drainage ditch system and the absence of vegetation (transpiration effects). Slug test derived hydraulic conductivities for the Upper Zone range from 2×10^{-3} to 1.0×10^{-5} cm/sec (see Table 3-4). Several generalizations can be drawn from the seasonal potentiometric maps summarized on Figure 3-9 and confirmed by the most recent measurement event of April 1992 (see Figure 3-11). It is noted that the potentiometric contours for January 1989 reflect the installation of well clusters east, southeast, and south of the previous study area. Observations concerning the groundwater flow pattern in the Upper Zone are:

- There is a year-round mounding of groundwater centered on the process area, and flow is radially outward from this area.
- The steepest year-round hydraulic gradient (0.01 ft/ft) is southwest from the process area to the natural depression in that direction. This area also has the

steepest ground surface relief. The shallowest year round hydraulic gradient (0.003 ft/ft) is generally to the east. The average hydraulic gradient across the site is on the order of 0.005 ft/ft.

o Average Darcian flow velocities, assuming an effective porosity of 0.1, range from 0.5 ft/yr to 100 ft/yr.

o During the wet season (January recording event), there is a mounding of water around OW-25. During dry periods (July) there is a depressed water level in this area. This is recognized as a probable sinkhole area.

o Referring to Table 3-5 (water levels over a four year period for representative observation wells and average monthly rainfall data) the depth to water varies from 1 to 20 feet across the plant, and up to 10 feet between seasonal highs and lows. As would be expected in a karst terrane, water level fluctuations occur quickly following a rainfall event.

4.3.2 Lower Zone. The lowest portion of the residuum and the first five to ten feet of the Tuscumbia Limestone constitute what is termed the Lower Zone. Twenty-four observation wells are screened in this horizon. Lower Zone potentiometric contours approximating the four seasons of the year are shown on Figure 3-10 with the hydraulic conductivities presented on Table 3-4. The hydraulic conductivities derived from slug tests for this zone range from 6.4×10^{-3} to 6.4×10^{-6} cm/sec, with the exception of observation wells (OW-38 and OW-60) where rapid groundwater level recovery rates precluded in-situ testing and suggest localized channel flow. The range of conductivities conform to those of a relatively tight limestone (Freeze & Cherry [1979]). Observations concerning the Lower Zone hydrology, based primarily on the seasonal potentiometric contour maps, as confirmed by the most recent measurement event of April 1992 (Figure 3-12) include:

- o The site groundwater elevation pattern is similar to the Upper Zone, i.e., radial outward flow from the process area; the steepest hydraulic gradient is to the southwest; the shallowest is to the east. The average hydraulic gradient is on the order of 0.006 ft/ft.

- o Average Darcian flow velocities range from 0.5 ft/yr to 400 ft/yr.

- o There appears to be an intermittent groundwater divide in the area east of the closed landfill and west of the east property line.

4.3.3 Deep Zone. Six deep observation wells (DOW-1 through DOW-6), installed to depths of 119 to 150 feet, in what is termed the Deep Zone, permit qualitative evaluation of the deeper bedrock underlying the site. DOW-1 is in the vicinity of the Former South Impounding Basin. DOW-2 is east of the Closed Landfill, and DOW-3 is near the east plant property line. DOW-4 through DOW-6 were installed along the downgradient, western and southern boundary of the plant. DOW-1 and DOW-3 were typified by nearly continuous limestone cores and relatively low hydraulic conductivities (3.2×10^{-5} and 1.4×10^{-5} cm/sec). The limestone encountered in DOW-2 contained significant voids. Turbulent fluctuations in water level measurement precluded conducting field hydraulic conductivity tests in this well. However, it is apparent that the hydraulic conductivity of the material screened by DOW-2 is significantly greater than that screened by DOW-1 and DOW-3. DOW-4 encountered loose limestone rubble several feet thick at the top of the limestone interval, but was completed in a very tight limestone below the rubble. DOW-5 and DOW-6 encountered small fractures in the upper portion of the limestone and display intermediate hydraulic conductivities. The direction of groundwater movement in the deep zone (Figure 3-13) is consistent with the regional groundwater flow system, i.e., northeast to southwest beneath the OxyChem site enroute to the Tennessee River.

4.3.4 Upper Zone Vs Lower Zone Potentiometric Levels. Vertical hydraulic gradient between the Upper Zone and Lower Zone can be determined by considering potentiometric heads in cluster wells and the thickness of the clay/chert zone. The hydraulic gradient and direction of groundwater flow for the May 1988 measurement event are shown on Table 4-1. For most of the site, recharge/discharge response is consistent, with both the Upper Zone and Lower Zone wells increasing or decreasing at relatively the same rate, and the vertical hydraulic gradient being downward, as would be expected of a tight limestone whose recharge is governed by infiltration from above. However, during very wet periods in the area east of the landfill, the vertical gradient is upward and the water table is noticeably mounded. In some wells (e.g. OW-52) there is evidence of artesian flow. Water in voids in the underlying limestone is likely pressurizing the residuum in such areas.

4.4 General Hydrogeologic Information. The site hydrogeological system is quite complex. Displaying site specific geologic and hydrologic information together and including selected mercury and chloride data from each well location assist in the understanding of the regolith/limestone interface, the degree of weathering or solution of the bedrock and the actual/potential migration of constituents. Table 4-2 was prepared to show such data and includes:

- o Depth/description of limestone coring in the well boring
- o Description of soils immediately overlying the limestone
- o Mercury and chloride concentrations in soil samples immediately overlying the limestone
- o Mercury and chloride concentrations measured during recent sampling events
- o Hydraulic conductivity of screened section in Lower Zone observation well
- o Hydraulic conductivity of screened section in companion Upper Zone observation well

The following observations can be made based on Table 4-2, reference to borings logs, and the preceding discussions:

- The limestone under the plant proper appears to be solid and relatively unfractured based on nearly continuous core recoveries.

- The low area to the north and northeast of the landfill was likely formed as a result of sinkhole activity (settling of regolith and limestone into a fairly shallow underlying solution cavity).

- The highest limestone elevations are found in the areas of OW-48 and OW-25 (see Figure 4-4). In the vicinity of OW-25, there is a notable surface depression. This low relief and the resiliency of recharge and discharge (water level fluctuations in OW-25 and OW-26) suggest a solution cavity below an apparently intact limestone cover.

- The relatively high hydraulic conductivities of the Upper Zone (2.0×10^{-3} to 1.0×10^{-5} cm/sec) do not conform to expected values for clay (10^{-7} to 10^{-8} cm/sec) or to the laboratory and field tested values (7.4×10^{-6} to 5.6×10^{-7} cm/sec) for surface clay cap material on the closed landfill measured by Woodward Clyde and referenced in Table 2-2. This suggests a significant difference in soil structure between in-situ and remolded (compacted) residuum material. It is noted that there is a significant increase with depth in the amount of chert fragments in the clay matrix beginning at depths of 10 to 30 feet. There apparently is sufficient secondary structure (jointing, fissures, etc.) within the clay and chert residuum to provide preferential faster-moving flow paths.

SECTION 5

SITE ASSESSMENT AND INTERPRETATION

5.1 Constituents of Concern. The OxyChem facility, since its initial construction and operation by others in the 1950s, has been a chlor-alkali production facility utilizing mercury cells and salt (NaCl or KCl) as its raw materials. By characterization of waste streams and analysis of groundwater samples (including Appendix IX parameters) from the known plume area, it has been confirmed that the hazardous constituents of concern are mercury (Hg) and cadmium (Cd) and the non-hazardous constituent of concern is chloride (Cl). There has been no evidence of organics of any kind being present in waste streams or the groundwater. Table 3-7 summarizes the Appendix IX analyses, which are provided in their entirety in Appendix E of Volume I (Sampling Event from October 1988).

5.2 Interim Status Monitoring Data. The monitoring data for sampling events conducted at the Muscle Shoals facility during the period December 1987 through April 1992 and presented in Tables 3-8 (Hg), 3-9 (Cd), and 3-10 (Cl), reflect filtered and non-filtered data. The assessments made in this section are based on the unfiltered data of April 1992. Beginning with the April 1992 sampling event, analyses will be for total constituent concentrations, based on the aforementioned directions from USEPA. A review of Tables 3-8 to 3-10 reveals that the total and filtered data are generally in agreement. However, to confirm this observation and to establish background data, three additional quarterly sampling events will be conducted and evaluated (see Volume III, Groundwater Monitoring). In the event that the total analysis background data show a different picture than the data used in this assessment, ADEM and USEPA will be advised.

5.3 Waste Pile B Sources. The field investigation discussed in Section 3 has identified the area south of the mercury cell building as being the centroid/origin of elevated Hg, Cd, and Cl concentrations in the soil and groundwater. Coincidentally, former Waste Pile B is located in this area; although, it is not believed to be a significant contributor to the observed Hg, Cd, and Cl concentrations. It is believed that four other sources have contributed the bulk of the Hg, Cd, and Cl observed. The four sources are (1) the industrial sewer lines located south of the mercury cell building; (2) the former salt storage piles; (3) the former NaCl and KCl brine precipitation basins; and (4) the former South Impounding Basin. Programmatically, the exact superposition of Waste Pile B over the center of effected groundwater permits the utilization of the same assessment discussion to address (1) the historical ADEM interest in corrective action and (2) the ADEM/USEPA requirements for the Waste Pile B post-closure permit application and associated RCRA Facility Investigation (RFI). Accordingly, after introducing the principal constituent sources in this section, the assessment of Waste Pile B and the area south of the cell building is presented in (Section 5.4).

5.3.1 Industrial Sewer. The industrial sewer is a collection of lines as shown on Figure 2-4. The industrial sewer lines are believed to be a significant former source of mercury and a minor source of cadmium. The "hot" lines were the two to the south of the mercury cell building which collected the bulk of the general use water within the plant, much of which was water used to minimize mercury vapors in the extensive trench system. Since 1970, the cell building trench system water has been handled by an evolving treatment system, and the former "hot" lines have carried non-mercury laden process waters. The industrial sewer's effects on the soil and groundwater overlaps the areas influenced by the salt piles (which it essentially passes under) and the former South Impounding Basin.

5.3.2 Former Salt Storage Piles. Since the plant start-up in 1955, raw materials (NaCl and KCl [since 1963]) have been stockpiled outdoors on paved surfaces (see Figure 1-2). Prior to the elimination of NaCl as a raw material in 1991, two areas south of the mercury cell building were utilized to store NaCl. These areas consisted of 1) an area of approximately 15,000 square feet, located near the southeast corner of the mercury cell building (100 feet north of former Waste Pile B), and 2) a smaller area (10,000 square feet) approximately 150 feet east former Waste Pile B. Potassium chloride was stored in an area (approximately 5,000 square feet) located 250 feet southeast of former Waste Pile B. During the period in which KCl was stored in this area, a tarp was used to cover the stockpile materials. Potassium chloride materials are now unloaded from the railroad cars and are placed directly into the plant process system, eliminating a need for salt storage piles.

The elevated levels of Cl (and Cd as released from the soil due to elevated Cl) in the Upper and Lower Zone wells in the vicinity of the salt piles suggest that the salt piles have been the principal source and/or contributor of these constituents in the groundwater.

5.3.3 Former NaCl and KCl Precipitation Basins. The former NaCl precipitation basin (50 feet west of former Waste Pile B) and KCl precipitation basin (400 feet west of former Waste Pile B) were used to remove precipitates from the brine (see Figure 1-2). An in-line filtering system has replaced the brine precipitate basins in the process. The KCl precipitation basin was taken out of service in December 1991 with the NaCl basin following in March 1992.

5.3.4 Former South Impounding Basin. This 200 by 300 foot rectilinear surface impoundment (south/ southwest of former Waste Pile B, see Figures 1-2 and 2-1) was a settling basin for wastewater known to contain Hg. Sodium bisulfide was added to the wastewater to precipitate Hg prior to discharging to the industrial sewer system.

No documentation on the closure of the Former South Impounding Basin was available in the plant files. However, based on interviews with current plant personnel, the method of closure consisted of dewatering the basin, pushing the levees into the excavated area with a bulldozer to cover the basin, and seeding the top. The residual solids accumulated over the years from the settling process are believed to have been left in place. Elevated Hg levels in the Upper and Lower Zone wells in the vicinity of the south impoundment area are, in part, attributed to this feature.

5.4 Former Waste Pile B Area Assessment.

Mercury, Cadmium, and Chloride in Soil. Soil samples from borings B-2, B-13, B-16, B-19, B-20, and B-24 through B-31 (see Figures 3-7 and 3-8) were analyzed for Hg and Cl. Soil samples from borings B-37 and B-40 to B-42 (see Figure 3-8) were analyzed for Hg, Cd, Cl, and EP Tox Hg and Cd (see Table 3-2). The results of these analyses are the bases for interpreting the subsurface soil conditions in the former Waste Pile B area.

Mercury. Total Hg concentrations in the shallow soils (depths to 15-feet) ranged from 40 ug/kg (B-30 at 13-15-foot) to 42,100 ug/kg (B-37 at 4-feet below grade). EP Tox Hg concentrations for these same samples have ranged from non-detectable (<0.2 μg/l) to 219 μg/l. Below 15-feet, typical total concentrations ranged between 100 ug/kg and 400 ug/kg.

The highest Hg concentrations in the soils were observed in the area of the brine precipitation basins (B-26, B-29, B-37, B-41, B-42, and B-43) within 0 to 10 feet of the surface. The high levels of Hg in the 0 to 10 feet interval and the significant decrease in Hg concentrations below 10 feet demonstrates the soils ability to adsorb Hg. With the exception of B-37, the leachable (EP Tox) Hg concentrations were below 11 μg/l. Elevated levels of EP Tox mercury were observed at the 4 foot depth (219 μg/l) and 9 foot depth (78.4 μg/l) in B-37 with concentrations dropping off significantly after the 9 foot depth.

Cadmium. Cadmium soil analyses were conducted on the more recent borings (B-37, B-40, B-41, and B-42). Additionally, a Cd analysis was conducted on a composite sample collected from borings B-38 and B-39 to establish a background Cd level. The result showed the background concentration of Cd to be on the order of 3,600 ug/kg (see Table 3-3). With the exception of elevated Cd concentrations of 7,300 ug/kg and 5,700 ug/kg at 4 feet in borings B-41 and B-42, the Cd concentrations in the Waste

Pile B area were comparable to background levels. Leachable (EP Tox) Cd concentrations typically ranged from non-detectable (<0.1 μg/l) to 2 μg/l with one isolated sample (from 44-foot depth in B-40) showing an EP Tox Cd concentration of 3.9 μg/l.

Chloride. Chloride levels in soil were elevated in borings B-19, B-20, B-26, B-27, and B-28 ranging from 100 mg/kg to 43,500 mg/kg, with a typical concentration in the range of 2,000 mg/kg to 4,000 mg/kg. The chloride concentrations increased with depth to about 25 feet below the surface but then decreased notably. Chloride concentrations in the remaining borings (B-2, B-16, B-24, B-25, B-29, B-30, B-31, B-37, B-40, B-41, and B-42) were low to moderate ranging from less than 10 mg/kg to 6,720 mg/kg.

Mercury, Cadmium, and Chloride in Groundwater. The monitoring data collected from observation wells OW-5A, OW-6A, OW-27, OW-28, OW-46 through OW-49, and DOW-1 during the period, December 1987 through April 1992, is the bases for evaluating the groundwater conditions in the vicinity of former Waste Pile B. Constituent isopleths for the Upper and Lower Zones (presented in Figures 3-14 through 3-19), prepared from the April 1992 total (unfiltered) data, indicate the following.

Mercury. In the Upper Zone (see Figure 3-14), the concentrations of Hg in the groundwater range from 20.3 μg/l in OW-5A to 433 μg/l in OW-47. The concentrations of Hg in the Lower Zone (Figure 3-15) range from 1.3 μg/l in OW-48 to 237 μg/l in OW-6A. The Hg concentration in DOW-1 was non detectable (Table 3-8).

The 433 μg/l Hg concentration in OW-47 represents the highest value of Hg in the Upper Zone at the site. The elevated Hg levels in this area are believed to be the result of the industrial sewer which passes within 20 feet of the well location. The Hg observed at the OW-5A (20.3 μg/l) location is believed to be attributable to the Former South Impounding Basin.

In the Lower Zone (Figure 3-15), the value of 237 $\mu g/l$ in OW-6A is the highest at the site.

Cadmium. Cadmium concentrations in the Upper Zone (Figure 3-16) varied from 5.5 $\mu g/l$ in OW-49 to 29.5 $\mu g/l$ in OW-27. Lower Zone concentrations of Cd (Figure 3-17) ranged from 104 $\mu g/l$ in OW-6A to 297 $\mu g/l$ in OW-46. DOW-1 cadmium concentration was 5.9 $\mu g/l$ (Table 3-9).

Chloride. Referring to Figure 3-18 and Table 3-10, the concentrations of Cl in the Upper Zone monitor wells range from 4,525 mg/l in OW-5A to 93,250 mg/l in OW-49. The Lower Zone concentrations (Figure 3-19) range from 6,150 mg/l in OW-28 to 27,000 mg/l in OW-6A, with the exception of 55,500 mg/l in OW-46. The chloride concentrations in DOW-1 have ranged from 4,000 mg/l to 5,300 mg/l. The high concentrations of Cl in the Upper and Lower Zone wells are clearly associated with earlier open storage of salt for nearly 40 years.

As previously mentioned, a composite background soil sample was collected from boring B-38 and B-39 (Golf Course area). A Cd level of 3,600 ug/kg in the background sample indicates that Cd is a natural component of the soil matrix. It is believed that high concentrations of NaCl will alter the adsorption equilibrium between the clay soil and Cd, i.e., clay soils subjected to high concentrations of NaCl, will undergo ionic exchanges wherein Na exchanges for Cd, releasing some of the Cd to the groundwater. Referring to Tables 3-9 and 3-10, this phenomenon is evident in that elevated Cd levels detected in the groundwater appear to be associated with chloride concentrations greater than 5,000 mg/l.

Interpretation. A look at the seasonal potentiometric contours on Figures 3-9 and 3-10 reveals two aspects of the groundwater flow patterns which are consistent with the Hg plumes shown on Figures 3-14 and 3-15. First, there is a prevailing north-south running ridgetop cutting through the area of OW-48. It would seem that groundwater to the east of this ridge would move south and east. Secondly, there is a dome of groundwater which over the course of the year is centered on the cell building. If the source of elevated Hg were under the cell building, high Hg values would be expected to emanate radially from this structure. However, the higher concentrations being seen on the south side of the building suggests that the source is south of this prevailing dome of water, e.g., the industrial sewer and former South Impounding Basin. The finger of slightly elevated values to the northwest can be attributed to movement associated with groundwater drawdown by the former (now plugged) plant water wells (WW-1, WW-2, and WW-3 on Figure 1-2).

The Cl and Cd plume patterns are also consistent with the radial groundwater flow from the plant's process area. The Cl plumes are similar to the Hg plumes in general shape but larger reflecting the lack of interaction (adsorption) between Cl and the soil. The areas evidencing Cd coincide with areas where the Cl concentration exceeds 5,000 mg/l.

<u>5.5 Former North Impounding Basin Assessment</u>. The former north impounding basin is irregularly shaped and covers an area of approximately 65 acres (see Figures 1-2 and 2-1). During its earlier use (1970), influent to the basin was received at the basin's east end. Mercury and Cl soil analyses from borings B-9 through B-12 and B-18 (Figure 3-7) and for Hg, Cd and Cl groundwater analyses from monitor well clusters OW-29 and OW-30; OW-31 and OW-32; OW-33 and OW-34; OW-3 and OW-36; and OW-44 and OW-45 (see Tables 3-8, 3-9, and 3-10) are the bases for interpreting conditions in the vicinity of the Former North Impounding basin to depths ranging from 52 to 80 feet. All of the sampling pre-dated the decision to investigate both total and leachable (EP Tox) metal concentrations. Accordingly, the discussion below is based on the analysis for total concentrations.

<u>Hg and Cl in Soils</u>. With regard to Hg concentrations in the soil profile, all but two concentrations in near surface samples in boring B-10, were 70 ug/kg or less (see

Figure 3-7), except for boring B-18. In boring B-10, which was drilled in the levee roadway, the 3-foot sample had a Hg concentration of 67,000 ug/kg and the 6 foot sample had a Hg concentration of 5,300 ug/kg; however, the highest Hg concentration in the underlying 25 foot zone was only 30 ug/kg. It is possible that a portion of the roadway may have been constructed with fill material containing Hg. Borings B-9 and B-11 were also drilled through the levee roadway with soil samples indicating very low Hg concentrations (60 ug/kg or less). Boring B-18 was in the area of an abandoned industrial sewer outfall. The Hg profile (see Figure 3-7) exhibited a high-low-high profile, i.e., near the surface, 39,000 ug/kg, passing through a low of 50 ug/kg, and at bedrock, 280 ug/kg.

Cl levels were moderate in most of the soil samples from borings B-9, B-10 and B-11 (45 mg/kg to 775 mg/kg), but were low (90 mg/kg or less) in the samples from boring B-12 and B-18 (see Figure 3-7). The highest Cl concentrations in boring B-9 were 610 mg/kg and 775 mg/kg at the 15- and 20-foot depths, respectively. The highest Cl concentrations in boring B-10 were 860 mg/kg and 675 mg/kg at the 10 and 15 foot depths, respectively. The highest Cl concentration in boring B-11 was 390 mg/kg.

<u>Hg, Cd, and Cl in Groundwater</u>. Referring to Figure 3-14, the total (unfiltered) concentrations of Hg in the groundwater in the Upper Zone for the April 1992 data were very low, ranging from less than 0.2 μg/l (OW-3, OW-31, and OW-33) to 0.9 μg/l (OW-29), with the exception of a seemingly anomalous value of 8.0 μg/l in monitor well OW-45. The concentrations of Hg in Lower Zone water samples (see Figure 3-15) ranged from less than 0.2 μg/l (OW-30 and OW-44) to 0.4 μg/l (OW-36).

Cadmium levels at the Upper and Lower Zone monitor wells (see Figures 3-16 and 3-17) were either less than or equal to the drinking water standard of 5 μg/l.

Figure 3-18 shows Upper Zone groundwater Cl concentrations to be quite low (5.3 to 59.1 mg/l) with the exception of a 1,550 mg/l concentration found in the OW-29 water sample. Lower Zone groundwater Cl (see Figure 3-19) values ranged from 5.3 to 94.5 mg/l.

Interpretation. The Cl concentrations in soil samples and groundwater samples were generally consistent with the results of the conductivity geophysical survey. The anomalously high conductivity survey readings in the vicinity of OW-29 and OW-30 were confirmed by the elevated Cl value for OW-29 (1,550 mg/l).

The isolated slightly elevated Hg area in the southeast corner of the Former North Impounding Basin (Figure 3-14) is interpreted as reflecting localized influence of constituents settled in the bottom of the basin.

The favorable groundwater analysis history (see Tables 3-8, 3-9, and 3-10) during the period covered by this report (December 1987 to April 1992) confirms the extensive surface soils analysis conducted by Woodward Clyde in 1980/81 which concluded that the groundwater of the North Impoundment was not impacted.

5.6 Closed Landfill Assessment. The former landfill encompasses an area of nine acres and has a cap elevation varying from +530 to +540 MSL. It is bounded to the northwest, north, east, and southeast by areas of significantly lower elevation (+518 to +523 MSL). The conductivity survey data (Figures 3-2 through 3-5) in this area indicated a conductivity plume emanating from the closed landfill a limited distance (200 to 400 feet depending on depth) in northerly and easterly directions, suggesting the presence of Cl north and east of this feature.

Hg and Cl soil analyses from borings B-5, B-6, B-7, B-8, B-10, B-17 and B-32 (Figure 3-7) and Hg, Cl and, in some instances, Cd groundwater analyses from well clusters OW-11 & OW-12A; OW-13 & OW-14A; OW-15A, OW-15B & OW-16; OW-19 & OW-20A; OW-21 & OW-22; OW-23 & OW-24A; OW-52 & OW-53; and DOW-2; and DOW-3 (Tables 3-8, 3-9 and 3-10) are the bases for interpreting conditions in the vicinity of the closed landfill to depths ranging from 60 to 132 feet.

Hg and Cl in Soil. Referring to Figure 3-7, boring B-8 (west of the landfill) had moderate Hg concentrations ranging from 120 to 180 ug/kg. Boring B-7 (north of the landfill) had relatively low Hg concentrations except in soil samples at the 35-foot depth (130 ug/kg) and 75-foot depth (90 ug/kg). Boring B-10 (north of the landfill) also had relatively low Hg concentrations except for the 2-foot depth (67,000 ug/kg) and 5-foot depth (5,300 ug/kg). Boring B-6 (200 feet southeast of the landfill) had low Hg concentrations, with the exception of a moderate 240 ug/kg Hg concentration at the 50-foot depth. Boring B-17 located close to the eastern edge of the landfill had a relatively consistent Hg profile of 90 ug/kg to 65 feet with one moderate concentration of 570 ug/kg at 2 feet. Boring B-32 (500 feet east of the landfill) had concentrations ranging between 20 and 110 ug/kg to 67 feet except for a concentration of 480 ug/kg at 40 feet and 170 ug/kg at 45 feet. Boring B-5 (120 feet south of the landfill) had consistently low Hg concentrations.

In boring B-8 (referring to Figure 3-7), Cl concentrations were less than 50 mg/kg, except at the 55-foot depth where the Cl level was 185 mg/kg. In boring B-7, Cl values were elevated in the 5- to 25-foot zone (90 to 950 mg/kg), but significantly lower concentrations were found both above and below this depth zone. At boring B-10, north of B-7 by 700 feet, Cl fluctuated between 70 and 300 mg/kg except for higher readings of 860 mg/kg at 10 feet and 680 mg/kg at 15 feet. Both borings B-5 and B-6 had varying Cl concentrations (as high as 290 mg/kg near the base of boring B-5 and 765 mg/kg near the surface of boring B-6, and low values of less than 10 mg/kg). On the eastern edge of the landfill at boring B-17, Cl was elevated at the surface (11,500 mg/kg at 5 feet); less than 30 mg/kg between 13 feet and 35 feet; and between 110 and 1,100 mg/kg from 38 and 65 feet. Farther east, at Boring B-32, Cl was low ranging between 5 and 40 mg/kg.

Hg, Cd, and Cl in Groundwater. The Hg, Cd, and Cl concentrations in water samples from the Upper Zone and Lower Zone observation wells are found on Tables 3-8, 3-9, and 3-10. Constituent isopleth maps for each zone, based on April 1992 total (unfiltered) data, are shown on Figures 3-14 through 3-19.

With one exception, the concentrations of Hg in the landfill observation wells (Figures 3-14 and 3-15) were below detection limit or low in both the Upper Zone wells (<0.2 to 1.1 μg/l) and the Lower Zone wells (<0.2 to 2.2 μg/l). The exception is well OW-14A (Lower Zone), which has a Hg concentration of 8.2 μg/l. The Deep Zone Hg mean concentrations are 4.4 μg/l for DOW-2 and <0.2 μg/l for DOW-3.

Cadmium analyses (see Figures 3-16 and 3-17) were below detection limit (<5 μg/l) or low in all instances except for wells OW-20A, OW-21, and DOW-2 which showed concentrations of 32.9 μg/l, 10.0 μg/l, and 83.2 μg/l, respectively.

Chloride concentrations are depicted on Figures 3-18 and 3-19. The concentrations of Cl in the Upper Zone wells ranged from 1.8 to 2,587.5 mg/l. The concentrations of Cl in the Lower Zone wells were typically higher than the Upper Zone wells, and ranged from 24.4 mg/l (OW-12A) to 3,600 mg/l (OW-24A). In the case of DOW-2 and DOW-3, these Deep Zone wells have higher Cl concentrations (13,500 mg/l and 2,250 mg/l, respectively) than the other wells in their clusters.

Interpretation. The Cl plumes are consistent with the pattern of high conductivity values obtained by the geophysical surveys except that the chloride at greater depths east of the landfill is less than indicated, suggesting that the upper layers had a masking effect on the deeper soundings. The interpreted direction of both the Hg and Cl plumes (Upper and Lower Zones) are consistent with the groundwater flow patterns (Figures 3-9 and 3-10), with one anomalous exception. The exception involves the Hg concentration in OW-14A. It is suspected this is influenced by historical infiltration of plant area runoff, from the plant ditch north of the well cluster.

As a landfill which operated from 1954/55 to February 1980, this plant feature has received particular attention as a possible significant replenishing source. Several observations tend to mitigate against this conclusion.

- o The primary fill materials were insoluble muds backwashed from the process clarifiers, retorted sludges/filter cakes, and the principally insoluble precipitates cleaned from brine saturators. Over a twenty-five year period, these materials were deposited and left exposed. Much of the remaining mobil constituents entrained in the precipitates would have been dissolved and washed away prior to redistribution of the fill and capping in 1980.

- o The area utilized as the landfill was never excavated to create a basin for waste. The landfill is more accurately described as a surface storage area with a containment levee on its north and east sides, which was subsequently capped. The native clay layer (55 to 60 feet thick) beneath the landfill is an impeding stratum to vertical migration.

- o Groundwater from piezometer P-20 (installed in 1980 through the landfill and underlying soil profile into the bedrock), was sampled prior to its closure by G&E. As discussed in the May 1989 G&E report, Hg concentrations for P-20, prior to and after purging were 39 and 26 μg/l, respectively; Cl concentrations were 850 and 180 mg/l, respectively. These data do not indicate significant contamination especially considering that this piezometer was nothing more than a hole open for at least seven years allowing relatively unimpeded vertical migration of landfill leachate.

- o Findings from observation wells which ring the landfill indicate a very limited (both in terms of distance and concentration) migration of mercury, cadmium, and chlorides. The exceptions to this are the Deep Zone chloride levels of 13,500 and 2,250 mg/1 in DOW-2 and DOW-3, respectively. These values are consistent with the lack of adsorption by soils of chloride and the subsequent greater mobility of this constituent.

5.7 Contaminant Plume Description. Based on the soil, groundwater, and selected surface water samples analyzed for mercury, cadmium, and chlorides, the lateral and vertical extent of migration has been adequately defined. Inferred Upper and Lower Zone plume boundaries (based on the April 1992 data) at which drinking water standards are met are provided for Hg, Cd, and Cl on Figures 5-1 through 5-3, respectively. Upper-Lower Zone composite plumes for Hg, Cd, and Cl for the April 1992 sampling event are illustrated on Figure 5-4. To assist in visualizing horizontal and vertical migration, a cross section of the site, showing constituent concentrations, is presented on Figure 5-5.

Mercury. The mercury plumes are centered on the mercury cell building and extend in the northeast/southwest direction (Figures 3-14 and 3-15). The closed landfill defines the northeast limit of the plumes while the area of stressed vegetation (south of the former south impoundment basin) delineates its southwest limit. In the Lower Zone, a third arm is extended in the northwest direction toward a now abandoned and sealed water well located near the plant entrance. The data for that well is based on a sampling event made on September 14, 1988. The evolution of the plumes is consistent with the groundwater flow pattern with the exception of the elevated concentration in a northwest direction from the cell building. Drawdown associated with the historical use of the closed water wells in this area is a reasonable explanation for this observation. The Hg plume in the Upper and Lower Zones is confined to the OxyChem facility.

The extent of horizontal migration in the deeper limestone (Deep Zone) is based on data from six deep observation wells. Samples from the three downgradient wells (DOW-4, DOW-5, DOW-6) and the most upgradient well (DOW-3) have Hg concentrations below the detection level. In the area between these wells, DOW-1 has had a Hg concentration of $<0.2\ \mu g/l$ and DOW-2 a concentration of $10.1\ \mu g/l$.

Cadmium. Elevated Cd concentrations are centered on the area south of the mercury cell building (Figures 3-16 and 3-17). With two exceptions, observation wells outside this area had no detectable Cd. The exceptions are Lower Zone well OW-20A with a concentration of 33 μg/l and Deep Zone well DOW-2 with a concentration of 83.2 μg/l. Again, all of the observed Cd concentrations are from wells with Cl concentrations in excess of 5,000 mg/l.

Chloride. Chloride plumes bound the extent of Hg and Cd migration (Figures 3-18 and 3-19). The Cl plumes are bi-nodal with the considerably larger node centered on the three former salt piles south of the mercury cell building and the much smaller node at the former landfill.

Chloride concentrations are below drinking water standards in the three downgradient Deep Zone wells (DOW-4, DOW-5, and DOW-6). The upgradient well (DOW-3) initially had a Cl concentration of 1,200 mg/l (January 1989) and raised the concern that the Cl plume might extend offsite to the east. As a result, the domestic well immediately offsite on Bel-Yor Road was sampled and analyzed; the findings were (1) no observed Hg or Cd, and (2) no Cl above background level (15 mg/l). Between the upgradient and downgradient wells, Deep Zone wells DOW-1 and DOW-2 had Cl levels of 4,650 mg/l and 13,500 mg/l, respectively, in April 1992.

SECTION 6
GROUNDWATER ASSESSMENT CONCLUSIONS

Extensive subsurface assessment activities have been conducted at the OxyChem Muscle Shoals facility since November 1987 as documented in the (1) Groundwater Assessment Report of May 1989, (2) Supplemental Groundwater Assessment Report of July 1991, and (3) herein. Mitigation measures have been undertaken at the facility during this period in response to the findings of assessment. The investigative activities over a nearly five year period have provided, not only definition and understanding of the nature and magnitude of soil and groundwater impact at the site, but also have provided a picture of the impact over time. Based on the investigative findings, evaluations, and computations undertaken during this assessment and mitigation period, the findings and conclusions are as follows:

- o The groundwater beneath the site has been impacted by industrial activities at the facility.

  - Plumes of mercury, cadmium, and elevated chloride have been defined in the groundwaters of the 50- to 70-foot thick clayey soil (Upper Zone and Lower Zone) overlying the Tuscumbia limestone (Deep Zone).

  - With the exception of chloride, these constituents have not been detected at significant concentrations in monitor wells within the Deep Zone.

- o Areally, the mercury and cadmium plumes are confined well within the plant boundaries. The chloride plume is confined within the plant boundaries except due east of the closed landfill where elevated chloride concentrations may extend a limited distance offsite to the east.

- o There is no evidence of any adverse impact to offsite groundwater or surface waters relating to the constituent plumes at the OxyChem site.

- o Dye-tracing studies (1991 Supplemental Groundwater Assessment) confirm a hydraulic conduit-flow connection between the Deep Zone beneath the site and Tuscumbia Springs to the southwest, a municipal potable water supply. These results corroborate the previous similar studies performed at the nearby Ford plant.

- o Therefore, constituents migrating vertically through the soil profile and entering the Deep Zone beneath the site can potentially be transported to Tuscumbia Springs.

- o The migration of mercury in the soil is noticeably retarded compared to the velocity of the groundwater due to ion exchange interactions with the sodium and calcium ions in the native soil. The presence of high concentrations of chloride reduces, but certainly does not eliminate the retardation of mercury and cadmium migration.

- o Only chloride (a naturally occurring groundwater component) has been detected at statistically significant levels (approximately 20 mg/l) in Tuscumbia Springs over the past 15 to 35 years. Mercury and cadmium have been detected at the limits of analytical capability (mercury: no greater than 0.2 μg/l and cadmium: <0.5 μg/l to 2 μg/l). The detected concentrations of these constituents at the springs have remained relatively constant and well within the limits of drinking water standards as established by USEPA.

- o Mass balance calculations demonstrate that:

  - If all mass unaccounted for in inventory over the past 35 years less the mass still residing in the soil profile entered the Deep Zone beneath the site,

  - If all of that mass entering the Deep Zone traveled to Tuscumbia Springs, and

  - Then the expected concentrations at Tuscumbia Springs would be 0.68 μg/l mercury, 0.35 μg/l cadmium and 490 mg/l chloride. Note: The mass balance calculations are in Appendix A of Volume V of this application.) This is a "worst-case" scenario, which unrealistically assumes all of the impacted groundwater passes directly to Tuscumbia Springs in the course of one year.

- o However, as summarized above the actual Tuscumbia Springs concentrations are well below these worst-case concentrations indicating the worst-case scenario, which still is not significant, is not occurring.

- o Corrective actions have been undertaken at the OxyChem facility to eliminate or drastically reduce the source of mercury, cadmium, and chloride. These include:

  - Change in process to eliminate open storage of sodium chloride.

  - Change in process to eliminate brine pit precipitate basins.

  - Modification of wastewater treatment facility to reduce total residual chlorine and mercury in the effluent.

  - Upgrading of the landfill cap to improve surface drainage, provide greater encapsulation of constituent sources, and reduce leachate production.

- o With the constituent sources largely eliminated, the constituents currently in the soil profile beneath the site will potentially migrate to the Deep Zone in diminishing concentrations.

- o In the future, the concentrations of the mercury, cadmium, and chloride constituents at Tuscumbia Springs which, under the "worst-case" scenario, can be attributed to the OxyChem facility:

- Will become no greater than the concentrations have been historically, which is well within minimum drinking water standards,

- Will continue to be present over several decades as the residual constituents are flushed from the soil profile beneath the site, but

- Will steadily decline during that period since the source has been eliminated.

o There has been no past, is no present, and will be no future threat to human health or the environment posed by constituents entering the groundwater regime beneath the OxyChem facility.

The general conclusions drawn from the assessment and mitigation activities are:

o The industrial activities at the OxyChem facility have probably contributed a portion of the mercury, cadmium, and chloride detected in Tuscumbia Springs above background concentrations over the past 35 years.

o The concentration levels of these constituents historically and currently detected in Tuscumbia Springs pose no threat to human health; the concentrations will not increase in the future as a result of activities at the OxyChem facility.

o The sources of the constituents have been largely mitigated, and the residual constituents in the subsurface will be naturally remediated.

SECTION 7

TRANSITION TO RFI WORK PLANS

7.1 General. Sections 8 through 22 contain RFI Work Plans for the SWMUs and other areas of interest identified by USEPA as warranting further study (see Section 1.2). The individual work plans assume the reader has read Sections 1 through 6 and can apply the findings and interpretations of the site-wide groundwater assessment to the individual SWMU and AOC settings. The work plans refer to data and information specific to each SWMU or AOC and introduce tables, figures, and exhibits in Sections 1 through 6. The Work Plans have been written so that the reader can review data and graphical representations of data and independently confirm statements of fact and interpretation. In some instances work plans have been written for multiple SWMUs and/or AOCs where proximal locations or common concerns are involved.

RFI Work Plans were not prepared for SWMU 25 (former Waste Piles A and B), since both facilities are being addressed under other existing programs. A clean closure demonstration is being prepared for former Waste Pile A and the Part B Post-Closure permit application, submitted concurrently with the RFI Work Plans report, has been prepared for former Waste Pile B. An RFI Work Plan, as such, has not been prepared for Pond Creek, identified in the RFA report as neither a SWMU nor an AOC, but rather an offsite area of interest. For Pond Creek, as discussed in Section 22, OxyChem does propose to sample and analyze soils and sediments upstream and downstream of the plant.

7.2 RFI Work Plans - Section References. Presented below is a reference table which identifies by section the SWMUs and AOCs for which Work Plans have been prepared.

Section No.	SWMU and/or AOC
Section 8	Closed Landfill (SWMU 1)
Section 9	Former South Impounding Basin (SWMU 2)

Section 10	Former North Impounding Basin (SWMU 3)
Section 11	Former Salt Storage Piles (SWMU 4)
Section 12	Former Precipitation Basins (Sludge Pads) (SWMU 6)
Section 13	Mercury Cell Room Trench System (SWMU 7)
Section 14	Former Hypalon-Lined Storage Tank Location (SWMU 8) and Southern Stormwater Discharge Ditch (SWMU 23)
Section 15	Mercury Collection Vessel (SWMU 10)
Section 16	Scrubber Solution Treatment Tank (SWMU 13), Old East Outfall Ditch (SWMU 15), and Gravel Areas Adjacent to Electric Substation (AOC C)
Section 17	Industrial Sewer System (SWMU 14)
Section 18	Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24)
Section 19	NPDES Outfall Ditch (SWMU 16) and Old TVA Pipeline Right-of-Way (AOC B)
Section 20	Junkyard (AOC A)
Section 21	Old East Ditch (AOC D)
Section 22	Offsite Area (Pond Creek)

SECTION 8

RFI WORK PLAN - CLOSED LANDFILL (SWMU 1)

8.1 General. With OxyChem's purchase of the Diamond Shamrock Muscle Shoals chlor-alkali plant in 1986 and associated property acquisition environmental audit, the closed landfill on the eastern portion of the property (see Figure 1-5) was singled out as the most obvious potential source of concern. Site investigation activities undertaken by OxyChem continued the trend of previous years in accentuating the evaluation of this feature. It is OxyChem's belief that the landfill contents are well understood, its impact on surrounding soil and groundwater adequately baselined, and that the recent major upgrade to the landfill cap will insure that this feature has no significant impact beyond its boundaries. This work plan will substantiate this position and provide suggested actions to address the comments in the RCRA Facility Assessment (RFA) report prepared by the consulting firm of K. W. Brown for the USEPA.

The landfill is more correctly described as a waste pile which was closed in place by being covered with low permeability native clay soils. The unit operated from approximately 1955 to February 1980 when it was removed from service in anticipation of the then promulgated RCRA regulations. During the 25-year period of operation, mass balance based calculations estimate that 33,000 tons of clarifier backwash mud, 57,000 tons of saturator sludge, and 2,500 tons of retorted sump sludge and filter material were piled on the existing clayey soil which, as shown on Figure 4-1, are some of the thickest at the site ranging from 60 feet to 80 feet in depth. The sludges and filter material being precipitates and carbon material are by nature relatively immobile. Additionally, since the piles were open and subject to rainfall, some of the initially small amounts of mobile trace constituents would have washed away prior to capping.

In early 1980, the waste pile materials were redistributed in place and capped according to plans prepared by White Engineering, Inc.

8.2 Previous Investigations. Previous investigations included (1) a landfill evaluation by Woodward-Clyde Consultants, Inc. (Woodward-Clyde), 1980-1981, (2) a facility evaluation (including the landfill) by G&E Engineering, Inc. (G&E), 1987-1992, which included (3) major landfill cap upgrades in 1990.

Woodward-Clyde, 1980-1981. Immediately following the capping of the waste pile, Diamond Shamrock initiated an effort to evaluate the adequacy of the clay cover (November 1980). Nineteen borings were installed through the clay cap to establish its thickness (see Figure 8-1 for locations). Thicknesses ranged from 1.7 feet on the western edge where little or no filled material existed to 10.2 feet on the eastern edge where the bulk of the filled materials were placed. Both laboratory (1.0×10^{-5} to 4.7×10^{-7} cm/sec) and field (7.4×10^{-6} to 5.6×10^{-7} cm/sec) permeability values indicated that the cap consisted of adequately clayey materials.

Also in 1980, Woodward-Clyde installed seven piezometers (TP-19 to TP-25 on Figure 8-1) on the edge and within the landfill, with three of these penetrating the underlying limestone. No report exists to explain the purpose of piezometers, but considering when they were installed they were most likely used to describe landfill conditions and help in the decision of where to locate observation wells requested by the state of Alabama (observation wells OW-1 through OW-4 on Figure 1-2). Boring logs for the seven piezometers (see Appendix A of Volume I) have subsequently been utilized as additional evidence to the thickness of the clay cap and depth to native soil.

In February and March 1981, Woodward-Clyde installed additional observation wells (OW-5 through OW-24). Observation wells OW-19 to OW-24 formed a downgradient perimeter around the landfill. No formal reports or records other than well profiles (Appendix A of Volume I) and a few unsubstantiated informal notes were found for these wells.

G&E, 1987 to 1989. G&E's site-wide groundwater assessment provides information about the closed landfill. Groundwater assessment activities in the vicinity of the closed landfill included (1) a geophysical (electromagnetic conductivity) survey; (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells, (5) water level measurements; and (6) groundwater sampling over a nearly five-year period.

Seven exploration borings (B-5 [OW-14A], B-6 [OW-24A], B-7 [OW-20A], B-8 [OW-12A], B-10 [OW-32], B-17 [OW-43], and B-32 [OW-52], see Figure 3-6) were installed. Sixteen observation wells (Figure 1-2) are located in the vicinity (downgradient) of the closed landfill area; they include (by monitored zone):

- o Upper Zone: OW-13, OW-15A, OW-15B, OW-19, OW-21, OW-23, OW-43 (closed July 1990), and OW-53
- o Lower Zone: OW-14A, OW-16, OW-20A, OW-22, OW-24A, and OW-52
- o Deep Zone: DOW-2 and DOW-3

Soil exploration boring logs are presented in Appendix A of Volume I. Monitor well cross-section details are presented in Appendix A of Volume III as part of the groundwater monitoring program. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are included in Appendix D of Volume I. The geotechnical data for the aforementioned borings in which samples were subjected to geotechnical tests, and hydrogeological data for the borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near the landfill are provided as analytical testing soil profiles on Figure 3-7. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. Referring to Figure 3-1, a geophysical survey was conducted in the vicinity of the landfill. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters are shown on Figures 3-2 through 3-5, respectively. The findings of the geophysical survey in the closed landfill area are discussed in Section 3.2.1.

Landfill Upgrade, 1990. To supplement information from the 1980-1981 Woodward-Clyde clay cap evaluation, G&E installed twelve temporary piezometers (TP-1 to TP-12) and 19 hand auger borings (AB-1 to AB-8, W-1, W-1A to W-1D, and W-2 to W-7), see Figure 8-1 for location. In addition to providing data for determining cap thickness and depth to native soil, the twelve temporary piezometers provided water level measurements and groundwater samples for analyses. A summary of the hand auger boring details is provided on Table 8-1; groundwater elevation information from the temporary piezometers is provided on Table 8-2; analyses of the piezometer groundwater is shown on Table 8-3; and soil analyses (both total and leachable) is shown for some of the hand auger borings at Table 8-4. Clay cap thickness isopachs based on both the Woodward-Clyde and G&E data are shown on Figure 8-2 with typical thickness ranging from three to ten feet. The water elevation data is shown as potentiometric contours on Figure 8-3 and indicates groundwater mounding in a limited area on the east face of the landfill attributed to the existence of a poorly draining perimeter ditch.

In August and September 1990, the former landfill was upgraded to include the following activities:

- o Cutting and filling of the landfill area to accomplish the desired new contours. At no time was fill material encountered. Additionally, there were no instances when the heavy construction equipment encountered soft areas.

- o Installing a 30 mil geomembrane cover over the recontoured landfill.

o Covering the geomembrane with topsoil and establishing an effective vegetative cover.

The third landfill upgrade status report, summarizing the entire project, is provided as Exhibit 8-1. Included are the nuclear field density (soil compaction) reports. Also included are photographs showing the final contours of the reconfigured landfill prior to the growth of the fescue/wheat cover. It has been the observation since the establishment of the grass cover that it is difficult to appreciate the uniform contouring due to the wavy nature of a mature growth of grass. The landfill project drawings (to include an as built drawing) are provided as Exhibit 8-2.

<u>8.3 Environmental Setting</u>. Located east of the OxyChem facility process area, the former landfill (capped waste pile) stands 5 to 15 feet above the surrounding grade at between 525 feet and 540 feet above mean sea level (see as built Drawing No. S455-585-12). Drainage away from the feature is in all directions from the crest shown on the as built drawing and Figure 4-6. To the north and east surface flow is unchanneled sheet flow in those directions. To the south, rainwater is collected in an asphalt ditch which discharges via a culvert at its center into the "Old East Ditch" (Area of Concern D). To the west, drainage is to an asphalt ditch which is graded to the north and discharges into the current plant NPDES ditch (SWMU 16).

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figures 4-2 and 4-3 encompass the unit. The upper stratum consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is encountered at a depth of about 60 to 80 feet (see Figure 4-1). These clay depths are some of the deepest at the facility.

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12), respectively flows radially to the northeast, east, and southeast, although the un-named Pond Creek tributary approximately 500 feet east of the landfill forms a groundwater divide precluding further migration to the east. Groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of representative in-situ hydraulic conductivity tests in the vicinity of the landfill (conducted in OW-21 [Upper Zone] and OW-22 [Lower Zone]) are 2.5×10^{-5} cm/sec and 4.8×10^{-4} cm/sec, respectively. Two Deep Zone wells are downgradient of the landfill. The closer well (DOW-2) is screened in an area of fast groundwater recovery where water level response precluded the determination of hydraulic conductivity. Approximately 500 feet farther east of DOW-2, DOW-3 is screened in competent limestone with a hydraulic conductivity of 1.4×10^{-5} cm/sec.

8.4 Source Characterization. The former landfill area was operated from 1955 to 1980 as a waste pile for three principal process wastes:

- o Salt Saturator Vessel Precipitates. During the initial dissolving process, rock salt is added to depleted brine to return it to saturation. A portion of the rock salt does not dissolve and collects at the bottom of the saturators forming a rock-like precipitate which had to be removed periodically by closing the saturator and breaking the material out with jack hammers. It is estimated that 57,000 tons of this material was piled during the 25-year landfilling period. Although subjected to trace amounts of Hg since the depleted brine had cycled through the mercury cells, Hg in this material is essentially immobile. The residual Cl on the material would have some degree of mobility. As a capped waste this rock-like material possesses excellent load-bearing capabilities and would not be expected to settle.

- o Clarifier Backwash Precipitates. Prior to returning to the mercury cells, replenished brine would be filtered an additional time through clarifiers. The clarifiers would periodically be backwashed to remove the precipitated (sand-like) deposits. The backwash would be permitted to settle in precipitation basins (one each for NaCl and KCl). The liquid collecting on the top would be returned to the brine loop. The dried precipitated (sand-like) deposits would be transported to the site waste pile area (subject landfill). An estimated 33,000 tons of clarifier backwash precipitates were generated during the 25 year period of operation of the site waste pile. As with the saturator materials, the precipitates are primarily non-mobile inert materials with trace amounts of Hg and residual Cl. As a sand-like material, the waste would have excellent load-bearing capabilities with negligible tendencies for settlement.

o Filter Materials. At a number of points at the facility, carbon filters are utilized to remove trace amounts of mercury from product streams. Periodically, these filters are recharged with fresh carbon. The removed carbon materials are retorted to recover as much entrained Hg as possible, and during the 25 year operation of the site waste pile, placed at that location. It is estimated that 2,500 tons (less than 5% of the total landfill contents) of this type of material was piled at the landfill location. Given the established ability for carbon filter material to adsorb and retain residual components, the retorted material is not believed to have significant mobility. As a minimal component of the total filled material, the carbon materials are not believed to be of significance in determining the inherent load-bearing nature of the current landfill.

8.5 Characterization of Release and Hazardous Constituents. As discussed in Section 5.6 and expanded upon in the Landfill Upgrade portion of Section 8.2, the landfill is recognized as a lesser source of Hg, Cd, and Cl in defining the overall extent of these three constituents at the site. However, since the landfill is sitting on 60 to 80 feet of undisturbed native clay and is covered with an impermeable geomembrane and clay cap, it is believed that its impact is historical in nature and that currently, significant releases are no longer possible.

8.6 Potential Receptors. There are no surface or above-grade sources remaining at the facility; therefore, there will be no exposure potential associated with direct contact or inhalation of airborne constituents. The only potential points of exposure would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to the Tennessee River. Downgradient of the Hg and Cd plumes, which are confined to the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. There is no current groundwater exposure of Hg, Cd, or Cl to humans at the TVA site (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to hazardous constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has been and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

8.7 Conclusions and Proposed Investigations. The assessment work conducted during the past five years has fully defined the environmental setting, geology, hydrology, and groundwater flow patterns near the landfill. Constituents of concern associated with the former waste pile beneath the landfill cap are known based on process activities and use of the area. The extent of constituents present in groundwater in the vicinity of the landfill is known, and there has been no evidence during the past five years of significant change in the constituent plumes. Although OxyChem believes the landfill to be well characterized and properly constructed, there were several concerns raised in the RFA report which have not been covered in the assessment of this submittal. They can be summarized as follows:

- o The cap has areas of inadequate vegetation and occasional surface deficiencies (erosion, ant/animal activity). There are locations on the perimeter asphalt drainage ditches which require repair.

- o An area at the southwest corner of the landfill does not appear to adequately drain.

- o The landfill may experience settling and resulting depressions in the cap.

- o The former use of polychlorinated biphenyls (PCBs) materials at the facility brings into question the possibility of these materials being in the landfill.

Additional investigation is proposed to address the additional concerns surfaced in the RFA report.

<u>8.7.1 Project Management Plan</u>. The proposed additional investigation parallels the concerns summarized in the preceding section.

- o The scattered instances of erosion, animal activity and ditch damage are expected occurrences in the establishment of a new landfill cap. OxyChem has an ongoing cap inspection and maintenance program. As part of the RFI, the areas noted during the visual inspection will be repaired and photographs submitted with the RFI report. OxyChem's inspection and maintenance program will continue beyond the RFI process.

- o The concern of inadequate drainage is believed to be unfounded. During the Visual Inspection it was raining and the noted water was moving rather than standing. Additionally, the area noted was in the southwest corner of the landfill area in a location were there is no fill material believed to be below the liner. The spot was also immediately adjacent to the western drainage ditch. Part of the difficulty in judging whether or not the cap is adequately contoured is due to the uneven (matted down) stand of grass which gives a noticeable wavy appearance to the area. For this reason a cap construction status report with color photographs of the cap prior to grass cover is provided as Exhibit 8-1 as a better portrayal of the slope.

- o Relative to the cap settling, this is not believed to be a concern. Given the rock-like or sand-like nature of the bulk of the filled materials, it is very unlikely that this would occur. It is also of significance that the filled material has been distributed and in place for 12 years, and it is typically the case with compressible materials that subsidence will begin immediately after construction of a landfill cap. Additionally, there were no indications of soft spots or subsidence with the use of heavy equipment during the landfill upgrade in 1990. Accordingly, it is proposed that subsidence be addressed as an inspection item during the annual ongoing inspection and maintenance program for the landfill.

- o Relative to the use of PCBs in the plant and the concern that these materials may have been landfilled, it is proposed to analyze the landfill perimeter wells (OW-13, OW-14A, OW-19, OW-20A, OW-21, OW-22, OW-23, OW-24A, and DOW-2) for PCBs and include the results in the RFI report.

- o Water level measurements and sampling (unfiltered) and analysis of observation wells for Hg, Cd, and Cl (included in the proposed site-wide groundwater monitoring program presented in Volume III) will continue.

The RFI report will present the new and previously-accumulated data and analyses, and will provide conclusions and recommendations specific to the landfill. Engineers, geologists, or environmental specialists familiar with the site will perform the sampling, and will prepare the RFI report from new and existing information. Analyses will be performed by SPL Laboratories in Lafayette, Louisiana. It is anticipated that the RFI report can be submitted within 120 days of notice of acceptance of the Work Plan.

8.7.2 Sampling and Analysis Plan. The monitor wells listed in Table 8-5 will be sampled and analyzed in accordance with the Sampling and Analysis Plan in Appendix A. Appendix A also includes analytical methodologies and detection limits.

8.7.3 Data Management Plan. Data records will be maintained which include the unique sample code; the sampling raw data; the sample location and type; the laboratory analysis ID number; the constituents analyzed; and the results of the analyses. Field and analytical data collected in the course of the RFI will be organized and maintained in files. Tables will be prepared for water level and analytical data (organized by constituent). Figures based on the new and existing data will be presented in the RFI report to document findings and support conclusions and recommendations. Figures to be presented in the RFI report include site plans with sampling locations, constituent isopleth maps, and potentiometric maps.

SECTION 9

RFI WORK PLAN - FORMER SOUTH IMPOUNDING BASIN (SWMU 2)

9.1 General. The former South Impounding Basin (SWMU 2), shown on Figure 1-4, was a surface impoundment (approximately 200 feet by 300 feet) used as a settling basin for process wastewater from the mercury cell building. It was constructed by excavating the natural clayey soils and building clay levees along its perimeter. The surface impoundment was put into operation in 1970 and was deactivated in 1976 by dewatering the facility and backfilling the basin with the clay levees.

Sodium bisulfide was added to the wastewater (between 1970 and 1974) stored in the former South Impounding Basin to precipitate mercury prior to discharging impounded water to the Industrial Sewer System (SWMU 14). After 1974, excess wastewater was diverted to the impoundment while waiting treatment in the wastewater treatment system. The surface impoundment was replaced by a Hypalon Storage Tank (SWMU 8) in 1976, which was in turn replaced by a permanent 500,000 gallon holding tank in 1981.

9.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the former South Impounding Basin area. Groundwater assessment activities in the vicinity of the former South Impounding Basin included (1) a geophysical (electromagnetic conductivity) survey; (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells; (5) water level measurements; (6) groundwater sampling over a nearly five-year period; and (7) sampling and analyses of soil, groundwater, and sediment.

Three exploration borings (B-2 [OW-6A], B-13 [OW-28], B-29, see Figure 3-6) were installed and one surface soil sample (SS-1, see Figure 3-20 and Table 3-11) was collected near the former South Impounding basin. Six observation wells (Figure 1-2) are located in the vicinity (downgradient) of the former South Impounding Basin area; they include (by monitored zone):

- o Upper Zone: OW-5A, OW-27, OW-41
- o Lower Zone: OW-6A, OW-28
- o Deep Zone: DOW-1

Soil (sediment) sample SS-1 is southwest of the former basin and in close proximity to the Southern Stormwater Discharge Ditch (SWMU 23).

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are included as Appendix D of Volume I.

Geotechnical data, for the aforementioned borings in which soil samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near SWMU 2 are provided on analytical test (Hg and Cl) soil profiles on Figures 3-7 and 3-8. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. The analytical data for surface soil sample SS-1 is presented on Table 3-11. Referring to Figure 3-1, a geophysical survey was conducted in the vicinity of the former South Impounding Basin. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters in the area of SWMU 2 are shown on Figures 3-2 through 3-5, respectively. The findings of the geophysical survey in the former South Impounding Basin area are discussed in Section 3.2.3.

9.3 Environmental Setting. Located south of the OxyChem facility process area, the former South Impounding Basin has an elevation of between 530 and 535 feet above mean sea level (see Plant Topographic Map, Figure 2-7). Site drainage (see Figure 4-6) is principally governed by the topography in the area inclusive of the former South Impounding Basin. In the area to the north, ditches have been created which channel surface flows to a sump in the southeast corner of the plant, where the initial flow of each storm is treated for the removal of mercury and salt residues prior its discharge through the wastewater drainage system to the NPDES Outfall Ditch (SWMU 16, Figure 1-5). Conforming to the surface topography, the remaining surface flow coming from the former South Impounding Basin drains to the Southern Stormwater Discharge Ditch (SWMU 23, Figure 1-4).

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figures 4-2 and 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is encountered at a depth of about 50 to 55 feet (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows to the south-southwest while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of representative in-situ hydraulic conductivity tests in the vicinity of the former South Impounding Basin (conducted in OW-27, OW-28, and DOW-1; see Table 3-4) are 3.2×10^{-5} cm/sec in the Upper Zone, 2.0×10^{-5} cm/sec in the Lower Zone, and 3.2×10^{-5} cm/sec in the Deep Zone.

9.4 Source Characterization. During the period 1970 to 1974 the former South Impounding Basin received approximately 2,000 gallons per day of wastewater from the Mercury Cell Room Trench System (SWMU 7). Sodium bisulfide was added to the wastewater stored in the basin to precipitate mercury prior to discharging to the Industrial

Sewer System. Seepage of wastewater into the subsurface soils minimized the volume of wastewater discharged to the Industrial Sewer System. Between 1974 and 1976, excess wastewater was stored in the surface impoundment awaiting treatment.

The hazardous constituents of concern in connection with the former basin are Hg and Cd, and the non-hazardous constituent of concern is Cl, associated with the former use of the basin and the suspected presence of residual (precipitated) materials beneath the backfill. Seepage loss from the former basin during its operation is probable given the absence of a liner. Rainfall infiltration in the area would be expected to contribute to the leaching of covered residual materials.

9.5 Characterization of Release and Hazardous Constituents. As discussed in Section 5.3, the Former South Impounding Basin is recognized as a probable contributor to the Hg, Cd, and Cl plumes associated with the former Waste Pile B area. The assessment of this area is presented in Section 5.4. Plume maps (Hg, Cd, and Cl) presented on Figures 3-14 through 3-19 and Figure 5-4, show the former South Impounding Basin to be near the centroid of the plumes. The extent of the hazardous constituents (Hg and Cd) has been defined. Groundwater impact associated with the former South Impounding Basin is an inextricable part of the aggregate impact of multiple former sources being addressed in terms of groundwater monitoring and corrective action under OxyChem's Part B Post-Closure permit application for former Waste Pile B submitted concurrently with this RFI Work Plan.

9.6 Potential Receptors. There are no surface or above-grade sources remaining at the facility; therefore, there will be no exposure potential associated with direct contact or inhalation of airborne constituents. The only potential points of exposure would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to the Tennessee River. Downgradient of the Hg and Cd plumes, which are confined to the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. There is no current groundwater exposure of Hg, Cd, or Cl to humans at the TVA site (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to hazardous constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has been and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

<u>9.7 Conclusions and Proposed Investigations</u>. The assessment work conducted during the past five years has fully defined the environmental setting, geology, hydrology, and groundwater flow patterns in the vicinity of the former basin. Constituents of concern associated with the former basin are known based on process activities and use of the basin. The extent of constituents present in groundwater in the vicinity of basin is known, and there has been no evidence during the past five years of significant change in the constituent plumes. Additional investigation is, however, proposed to define the nature, extent, and significance of residual precipitates covered with levee fill when the basin was closed.

<u>9.7.1 Project Management Plan</u>. The proposed additional investigation consists of (1) 11 exploration borings (see Figure 9-1), 10 of which will be 20 feet deep (sufficient to sample buried precipitates and a minimum of 10 feet of underlying soil), and one (the center boring) advanced to bedrock, (2) analysis of recovered soil and precipitate material for total and TCLP Hg and Cd and for total Cl, and (3) continued water level

measurements and sampling and analysis of existing observation wells (included in the proposed site-wide groundwater monitoring program presented in Volume III).

The RFI report will present the new and previously-accumulated data and analyses, and will provide conclusions and recommendations specific to the former basin. Engineers, geologists, or environmental specialists familiar with the site will perform the sampling, and will prepare the RFI report from new and existing information. Exploratory boring installations will be performed by TTL, Inc. or Miller Drilling Company under the oversight of an experienced engineer or geologist. Analyses will be performed by SPL Laboratories in Lafayette, Louisiana. It is anticipated that the RFI report can be submitted within 120 days of notice of acceptance of the Work Plan.

9.7.2 Sampling and Analysis Plan. Eleven vehicular-mounted exploratory borings will be drilled utilizing hollow-stem drilling techniques. Soil samples will be collected on five-foot centers to the bottom of the 20-foot boring. Soil samples in the center boring will be collected on five-foot centers to top of limestone. The exploratory borings will be closed and abandoned by tremie grouting the boreholes with a thick cement-bentonite mix. Data from previous investigations will be incorporated in the RFI report. The monitor wells listed in Section 9.2 will be sampled and analyzed in accordance with the Sampling and Analysis Plan in Appendix A; drilling, sampling, and field measurements will also be accomplished according to protocols contained in Appendix A. Soil and groundwater analytical methodologies and detection limits are included in the Sampling and Analysis Plan of Appendix A.

9.7.3 Data Management Plan. Data records will be maintained which include the unique sample code; the sampling raw data; the sample location and type; the laboratory analysis ID number; the constituents analyzed; and the results of the analyses. Field and analytical data collected in the course of the RFI will be organized and maintained in files. Tables will be prepared for geotechnical, geophysical, water level, and analytical data (organized by constituent). Figures based on the new and existing data will be presented in the RFI report to document findings and support conclusions and recommendations. Figures to be presented in the RFI report include site plans with sampling locations, constituent isopleth maps, potentiometric maps, and subsurface soil profiles.

SECTION 10

RFI WORK PLAN - FORMER NORTH IMPOUNDING BASIN (SWMU 3)

10.1 General. The original Pond Creek tributary was dammed in 1970 at the plant's western boundary to create a temporary surface impoundment, the former North Impounding Basin (SWMU 3), for wastewater and stormwater runoff (see Figure 1-5) while follow-on controls were being engineered and constructed. This surface impoundment covers an area of approximately 65 acres and is located north of the plant process operational area. Wastewater and surface runoff was received at the basin's east end. The former North Impounding Basin (SWMU 3) was operated from 1970 to 1971 to precipitate mercury from the wastewater and surface runoff prior to discharge through a NPDES permitted outfall. Sodium bisulfide was used to precipitate mercury from the impounded waters.

10.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the former North Impounding Basin area as does an investigation by Woodward Clyde Consultants, Inc. (WCC). G&E's groundwater assessment activities in the vicinity of the former North Impounding Basin included (1) a geophysical (electromagnetic conductivity) survey; (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells; (5) water level measurements; (6) groundwater sampling over a nearly five-year period; and (7) sampling and analyses of soil and groundwater. The WCC investigation of the former North Impounding Basin consisted of sampling and analysis of basin sediments (samples taken from 58 locations on a grid across the basin) for EP Tox metals.

Six exploration borings (B-7 [OW-20A], B-9 [OW-30], B-10 [OW-32], B-11 [OW-34], B-12 [OW-36], and B-18 [OW-44]; see Figure 3-6) were installed and sediment samples (see Exhibit 10-1, WCC site plan and data) were collected near or within the former North

Impounding basin. Thirteen observation wells (Figure 1-2) are located in the vicinity of the former North Impounding Basin; they include (by monitored zone):

- o Upper Zone: OW-3, OW-19, OW-29, OW-31, OW-33, OW-45
- o Lower Zone: OW-20A, OW-30, OW-32, OW-34, OW-36, OW-44
- o Deep Zone: DOW-4

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are described in Appendix D of Volume I.

Geotechnical data, for the aforementioned borings in which soil samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near SWMU 3 are provided on analytical tests (Hg and Cl) soil profiles on Figure 3-7. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. The analytical data for surface water and soil samples taken by WCC are presented in Exhibit 10-1. Referring to Figure 3-1, a geophysical survey was conducted throughout the former North Impounding Basin. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters in the area of SWMU 3 are shown on Figures 3-2 through 3-5, respectively. The findings of the geophysical survey in the former North Impounding Basin area are discussed in Section 3.2.2.

10.3 Environmental Setting. Located north of the OxyChem facility process area, the former North Impounding Basin was formed in a naturally low flat area with an elevation of approximately 518 to 519 feet above mean sea level (see Plant Topographic Map,

Figure 2-7). Site drainage (see Figure 4-6) from this area is into Pond Creek through the NPDES outfall located near the basin's western end, east of Wilson Dam Road.

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figures 4-2 and 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is encountered at a depth of about 45 to 85 feet (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows in a northerly direction from the basin, while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of in-situ hydraulic conductivity tests (Table 3-4) in the vicinity of the former North Impounding Basin vary significantly from relatively low values for the materials concerned to relatively high values (at the east end of the basin). The results of representative tests conducted in wells OW-45, OW-44, and DOW-4 were 1.0×10^{-4} cm/sec in the Upper Zone, 7.4×10^{-5} cm/sec in the Lower Zone, and 8.2×10^{-7} cm/sec in the Deep Zone.

10.4 Source Characterization. The former North Impounding Basin served as a settling basin for wastewater and/or surface runoff for approximately 1 year (1970 to 1971). Wastewater entered the former basin at a rate of approximately 5,000 gallons per minute (gpm). Located within the boundaries of the former North Impounding Basin is the original Pond Creek tributary (flowing east to west parallel with the former basin's northern boundary). During the period 1953 to 1971, this tributary received process wastewater (approximately 8,000 gpm) via the old plant outfall ditch located within the former impoundment (see Figure 1-5).

The primary constituent of concern in the former impounded waters is Hg; Cd and Cl are not a concern. Use of the sodium bisulfide precipitation method was suspected of impacting the surface soils with Hg. Seepage loss from the former basin during its operation was a recognized possibility given the absence of a liner. Rainfall infiltration in the area would have been expected to contribute to leaching of any residual materials.

10.5 Characterization of Release and Hazardous Constituents. The results of the WCC sampling and analysis program in 1980 and 1981 showed insignificant levels of EP Tox Hg; 3 of 58 sampling locations showed Hg values (2.3, 3.8, and 5.7 μg/l) slightly in excess of the drinking water standard for Hg (2 μg/l). Table 10-1 summarizes the Hg and Cd results from the EP Tox analyses: the complete set of data is contained in Exhibit 10-1. As discussed in Section 5.5, the groundwater assessment findings of the former North Impounding Basin over a five-year period have revealed no significant concerns with regard to Hg, Cd, or Cl. The detection of elevated Cl concentrations (on the order of 1500 mg/l) in samples from Upper Zone well OW-29 (adjacent to the current NPDES ditch, see Figure 3-18) is believed to be a localized and insignificant anomaly; its companion Lower Zone well (OW-30) typically shows Cl levels on the order of 100 to 300 mg/l (see Figure 3-19).

10.6 Potential Receptors. There are no surface or above-grade sources at the former facility; therefore, there will be no exposure potential associated with direct contact or inhalation of airborne constituents. The only potential points of exposure would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to there being any measurable effect on the Tennessee River. Downgradient of the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. Based on the findings from these wells, there is no current groundwater exposure of Hg, Cd, or Cl to humans (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to hazardous constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has been and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

10.7 Conclusions and Proposed Investigations. The results of the earlier WCC study and the site-wide groundwater assessment conducted during the past five years has defined the environmental setting, geology, hydrology, and groundwater flow patterns in the area of the former North Impounding Basin. Constituents of concern associated with the former basin are known based on process activities and use of the basin. The extent of constituents present in groundwater in the vicinity of basin is known, and there has been no evidence during the past five years of any significant effect on the environment or groundwater from the former basin. No additional investigation is proposed other than continued monitoring of groundwater by the array of observation wells to be included in the site-wide groundwater monitoring program (Volume III). Accordingly, OxyChem believes that there is no reason to prepare a RFI report for this former unit.

10.7.1 Project Management Plan. Not applicable.

10.7.2 Sampling and Analysis Plan. Not Applicable.

10.7.3 Data Management Plan. Not applicable.

SECTION 11

RFI WORK PLAN - FORMER SALT STORAGE PILES (SWMU 4)

11.1 General. The three salt storage pads (SWMU 4) were located southeast of the Mercury Cell Building (Figure 1-4). The pads are no longer in use since the process feedstock conversion from NaCl to KCl occurred in September 1990. There were two NaCl stockpiles, which were uncovered, and one KCl stockpile which was covered with a tarp. The first NaCl pad was an irregularly shaped area of approximately 15,000 square feet, located about 100 feet from the southeast corner of the mercury cell building. The second and smaller area (approximately 10,000 square feet) is located 150 feet farther southeast. One NaCl pad had a concrete base with a curb and the other had an asphalt base with a curb. These pads handled 8,000 to 12,000 tons at a time (a throughput of up to 150,000 tons per year). The KCl pad had an asphalt base with a curb located about 300 feet east of the Former South Impounding Basin. It typically stored approximately 1,500 tons of salt (a throughput of up to 110,000 tons per year). The KCl is now staged and stored in hopper cars.

11.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the former salt piles. G&E's groundwater assessment activities in the vicinity of the salt piles included (1) a geophysical (electromagnetic conductivity) survey; (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells; (5) water level measurements; (6) groundwater sampling over a nearly five year period; and (7) sampling and analyses of soil and groundwater.

By virtue of their locations in the plant process area, the former salt piles were surrounded by borings and observation wells. The nearest borings to the salt piles (Figure 3-6) are B-16 [OW-41], B-19 [OW-46], B-28, B-30, and B-31. Six observation wells (Figure 1-2) are located in the vicinity of the former salt piles; they include (by monitored zone):

o Upper Zone: OW-27, OW-41, and OW-47

o Lower Zone: OW-28 and OW-46

o Deep Zone: DOW-1

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are provided in Appendix D of Volume I.

The geotechnical data, for the aforementioned borings in which samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near the salt piles are provided on analytical tests (Hg and Cl) soil profiles on Figures 3-7 and 3-8. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. Referring to Figure 3-1, a geophysical survey was conducted where possible around the former salt piles area. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters in the area are shown on Figures 3-2 through 3-5, respectively.

11.3 Environmental Setting. Located in the southeastern portion of the OxyChem facility process area, the former salt piles were in areas with elevations ranging from 527 to 532 feet above mean sea level (see Plant Topographic Map, Figure 2-7). Site drainage (see Figure 4-6) from the former salt pile areas is either to the wastewater drainage system and then to the NPDES Outfall Ditch (SWMU 16) or to the Old East Ditch (AOC D).

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figure 4-2 and Figure 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is encountered at a depth of about 50 feet (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows in a south-southeasterly direction from the salt piles area, while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of in-situ hydraulic conductivity tests (Table 3-4) in the vicinity of the former salt piles, as interpreted from wells OW-46, OW-47, and DOW-1 were 4.9×10^{-4} cm/sec in the Upper Zone, 3.4×10^{-5} cm/sec in the Lower Zone, and 3.2×10^{-5} cm/sec in the Deep Zone.

11.4 Source Characterization. No wastes were ever managed at these units; however, the salt piles have been identified as SWMUs based on evidence of routine, systematic release. The high chloride concentration in the soil is primarily attributed to the nearly forty years of uncovered surface storage of NaCl. On-going seepage and surface runoff have undoubtedly contributed to the chloride plume migration. Although underlain with concrete or asphalt, these piles were not covered and there was the potential for continuous dispersal: infiltration, runoff, and wind-borne dusts. The primary constituent of concern is Cl, which is non-hazardous, and, to a very minor degree, Cd, a trace element in the salt used.

11.5 Characterization of Release and Hazardous Constituents. The findings of the geophysical survey confirmed high conductivity levels indicative of Cl infiltration in the area of the former salt stockpiles (see Figures 3-2 through 3-5). As discussed in Sections 5.3 and 5.4, the groundwater assessment findings in the area inclusive of the former salt piles over a five-year period have revealed plumes of elevated Hg, Cd, or Cl in groundwater (see plume maps on Figures 3-14 through 3-19 and Figure 5-4). The constituent directly attributable to the salt piles area is Cl, which has resulted in a plume encompassing both the Hg and Cd plumes. Reference to the plume maps shows that the Cl plume attributable to the salt piles area is contained on the OxyChem property; the size and configuration of the plume have not changed significantly during the five-year monitoring period. Deep Zone observation well DOW-1 has shown elevated Cl values (on the order of 4500 to 5000 mg/l, Table 3-10); however, downgradient Deep Zone wells (DOW-4, DOW-5, and DOW-6; see Figure 1-2) have shown significantly lower Cl values ranging from 10 to 200 mg/l (Table 3-10). Groundwater impact associated with the former salt piles is an inextricable part of the aggregate impact of multiple former sources being addressed in terms of groundwater monitoring and corrective action under OxyChem's Part B Post-Closure permit application for former Waste Pile B submitted concurrently with this RFI Work Plan.

11.6 Potential Receptors. There are no surface or above-grade sources of Cl at the former facility; therefore, there will be no exposure potential associated with direct contact or inhalation of airborne constituents. Additionally, Cl is a non-hazardous constituent affecting humans from an aesthetics (taste) standpoint. The only potential points of exposure would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to there being any measurable effect on the Tennessee River. Downgradient of the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. Based on the findings from these wells, there is no current groundwater concern associated with elevated Cl related to the former stockpiles (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has and is being conducted by the TVA. TVA has concluded that there is no problem associated with mercury, cadmium, or chloride.

11.7 Conclusions and Proposed Investigations. The results the groundwater assessment work conducted during the past five years has defined the environmental setting, geology, hydrology, and groundwater flow patterns in the area of the former salt piles. The constituent of concern associated with the former salt piles is known. The extent of Cl present in groundwater in the vicinity of the salt piles is known, and there has been no evidence during the past five years of any significant effect on human health or the environment from the former salt piles. No additional investigation is proposed other than continued monitoring of groundwater by the array of observation wells to be included in the site-wide groundwater monitoring program (Volume III). Accordingly, OxyChem believes that there is no reason to prepare a RFI report for these former units.

11.7.1 Project Management Plan. Not applicable.

11.7.2 Sampling and Analysis Plan. Not applicable.

11.7.3 Data Management Plan. Not applicable.

SECTION 12
RFI WORK PLAN - FORMER PRECIPITATION BASINS (SWMU 6) (SLUDGE PADS)

12.1 General. The former NaCl and KCl precipitation basins (SWMU 6) are located in the southern portion of the plant process area. They were concrete-lined above-grade units for storage of brine precipitate (brine muds). The NaCl and KCl sludge pads were located 250 feet southwest and 200 feet south, respectively, of the Mercury Cell Building (see Figure 1-4). They have been recently taken out of service (1991 and 1992) and covered with a layer of asphalt. The function of the pads was solely to separate precipitates from the process brine. Unit throughput was approximately 2,500 tons per year for NaCl and 1,500 tons per year for KCl.

12.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the former precipitation basins. G&E's groundwater assessment activities in the vicinity of the salt piles included (1) a geophysical (electromagnetic conductivity) survey (to the south of the basins); (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells; (5) water level measurements; (6) groundwater sampling over a nearly five year period; and (7) sampling and analyses of soil and groundwater.

By virtue of their locations in the plant process area, the former precipitation basins are surrounded by borings and observation wells. The nearest borings to the former basins (Figure 3-6) are B-13 [OW-28], B-19 [OW-46], B-20 [OW-48], B-26, B-27, B-29, B-37, B-40, B-41, and B-42. Seven observation wells (Figure 1-2) are located in the vicinity of the former salt piles; they include (by monitored zone):

- o Upper Zone: OW-27, OW-47, and OW-49
- o Lower Zone: OW-28, OW-46, and OW-48

o Deep Zone: DOW-1

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are included in Appendix D of Volume I.

Geotechnical data, for the aforementioned borings in which samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near the former precipitation basins are provided on analytical tests (Hg and Cl) soil profiles on Figures 3-7 and 3-8. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. Referring to Figure 3-1, a geophysical survey was conducted to the immediate south of the former precipitation basin area. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters in the area are shown on Figures 3-2 through 3-5, respectively.

<u>12.3 Environmental Setting</u>. The former precipitation basins were in areas with elevations ranging from 528 to 529 feet above mean sea level (see Plant Topographic Map, Figure 2-7). Site drainage (see Figure 4-6) from the former basin areas is to the stormwater drainage system and then to the NPDES Outfall Ditch.

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figure 4-2 and Figure 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is encountered at a depth of about 47 to 50 feet (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows in a southerly direction from the former basins area, while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of in-situ hydraulic conductivity tests (Table 3-4) in the vicinity of the former salt piles, as interpreted from wells OW-48, OW-49, and DOW-1 were 4.7×10^{-4} cm/sec in the Upper Zone, 4.6×10^{-5} cm/sec in the Lower Zone, and 3.2×10^{-5} cm/sec in the Deep Zone.

<u>12.4 Source Characterization</u>. The precipitation basins were originally used to remove precipitates from the brine. Decanted brine fluids were extracted from the top and returned to the process. The brine muds were loaded into wastes containers for off-site disposal. The wastes managed by the units were carbonate and hydroxide precipitates with residual salts and mercury. The precipitation basins represent possible sources of chloride and minor sources of mercury and cadmium.

<u>12.5 Characterization of Release of Hazardous Constituents</u>. The findings of the geophysical survey indicate high conductivity levels (probable Cl infiltration) in the areas of the former basins (see Figures 3-2 through 3-5). As discussed in Sections 5.3 and 5.4, the groundwater assessment findings in the area inclusive of the former precipitation basins over a five-year period have revealed plumes of elevated Hg, Cd, or Cl in groundwater (see plume maps on Figures 3-14 through 3-19 and Figure 5-4). Reference to the plume maps shows that the former precipitation basins are located near the centroid of the plumes; the size and configuration of the plumes have not changed significantly during the five-year monitoring period. Deep Zone observation well DOW-1 has shown elevated Cl values (on the order of 4500 to 5000 mg/l, Table 3-10); however, downgradient Deep Zone wells (DOW-4, DOW-5, and DOW-6; see Figure 1-2) have shown significantly lower Cl values ranging from 10 to 200 mg/l (Table 3-10). Referring to Figure 3-8, soil borings B-37 (middle of the former NaCl precipitation basin), B-40, B-41, and B-42 (within the KCl precipitation basin) showed sharply decreasing total Hg levels (to less than 1 mg/kg) below a depth of 10 feet, though Cl values often remained

elevated. Groundwater impact associated with the former precipitation basins is an inextricable part of the aggregate impact of multiple former sources being addressed in terms of groundwater monitoring and corrective action under OxyChem's Part B Post-Closure permit application for former Waste Pile B submitted concurrently with this RFI Work Plan.

12.6 Potential Receptors. There are no surface or above-grade sources remaining at the former basins; therefore, there will be no exposure potential associated with direct contact or inhalation of airborne constituents. The only potential points of exposure to humans would be to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to there being any measurable effect on the Tennessee River. Downgradient of the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. Based on the findings from these wells, there is no current groundwater concern associated with Hg, Cd, or Cl (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

12.7 Conclusions and Proposed Investigations. The results the groundwater assessment work conducted during the past five years has defined the environmental setting, geology, hydrology, and groundwater flow patterns in the area of the former basins. The constituents of concern associated with the former precipitation basins are known. The extent of constituents in groundwater in the vicinity of the former basins is known, and there has been no evidence during the past five years of any significant effect on human health or the environment due to the basins. No additional investigation of these former facilities is proposed other than continued monitoring of groundwater by the array of observation wells to be included in the site-wide groundwater monitoring program (Volume III). Accordingly, OxyChem believes that there is no reason to prepare a RFI report for this unit.

12.7.1 Project Management Plan. Not applicable.

12.7.2 Sampling and Analysis Plan. Not applicable.

12.7.3 Data Management Plan. Not applicable.

SECTION 13

RFI WORK PLAN - MERCURY CELL ROOM TRENCH SYSTEM (SWMU 7)

13.1 General. The Mercury Cell Room Trench System (SWMU 7) is located in the Mercury Cell Building (see Figure 1-4). The original concrete cell trench system, which was constructed below grade, was removed and reconstructed with reinforced gunite and underlain with a layer of 12 mil polyethylene above approximately two feet of slag backfill. The upper surface of the trenches is coated with carboline epoxy.

The trenches are used as a collection system for wastewater containing mercury contaminants. A large percentage of the wastewater consist of wash down of the cell building as required by NESHAPS regulations of mercury chlor-alkali plants and the build-up of contaminants on the surface of the electrolytic cells. Wastewater collected in the trenches drains to the cell room sump. The wastewater is then routed to the facility wastewater treatment unit or wastewater storage tank (SWMU 19) in aboveground piping.

13.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the Mercury Cell Building. G&E's groundwater assessment activities in the vicinity of the facility included (1) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (2) completion of soil exploration borings as observation wells; (3) hydraulic conductivity testing of observation wells; (4) water level measurements; (5) groundwater sampling over a nearly five year period; and (6) sampling and analyses of soil and groundwater.

By virtue of its location in the plant process area, the Mercury Cell Building and its trench system are surrounded by borings and observation wells. The nearest borings to the Mercury Cell Building (Figure 3-6) are B-8 [OW-12A], B-19 [OW-46], B-20 [OW-48], B-21 [OW-50], B-22 through B-25, B-35 [OW-58], and B-36 [OW-60]. Thirteen observation wells (Figure 1-2) are located in the vicinity of the Mercury Cell Building; they include (by monitored zone):

- o Upper Zone: OW-11, OW-47, OW-49, OW-51, OW-59, and OW-61
- o Lower Zone: OW-12A, OW-46, OW-48, OW-50, OW-58, and OW-60
- o Deep Zone: DOW-1

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are provided in Appendix D of Volume I.

The geotechnical data for the aforementioned borings in which samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near the Mercury Cell Building are provided on analytical tests (Hg and Cl) soil profiles on Figures 3-7 and 3-8. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively.

13.3 Environmental Setting. Located in the central portion of the OxyChem facility process area, the Mercury Cell Building is in an area with elevations ranging from 528 to 529 feet above mean sea level (see Plant Topographic Map, Figure 2-7). Site drainage (see Figure 4-6) from the Mercury Cell Building is to the wastewater drainage system and then to the NPDES Outfall Ditch. The Mercury Cell Room Trench System drains to the cell room sump and collected wastewater is piped aboveground to the wastewater treatment facility or wastewater storage tank.

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figures 4-2 and 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is encountered at a depth of about 50 feet (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows in a somewhat radial direction from the Mercury Cell Building, with mounding evident in the central portion of the plant process area, while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of in-situ hydraulic conductivity tests (Table 3-4) in the vicinity of the Mercury Cell Building, as interpreted from wells OW-48, OW-49, and DOW-1 were 4.7×10^{-4} cm/sec in the Upper Zone, 4.6×10^{-5} cm/sec in the Lower Zone, and 3.2×10^{-5} cm/sec in the Deep Zone.

13.4 Source Characterization. The trenches are used to collect washdown water in the mercury cell building. The surface of electrolytic cells (located overhead) are rinsed on a regular basis to remove the buildup of contaminants. NESHAPS regulations also require chlor-alkali plants to wash down the floors in the mercury cell building on a daily basis. The wastewater collected in the trenches are drained to the cell room sump and are then routed to the facility's wastewater treatment plant.

The original concrete mercury cell room trenches, which were operational in the early 1960's, were removed and reconstructed with reinforced gunite. Approximately 2 feet of soil was removed below the trenches and replaced with slag. According to a former employee of the Muscle Shoals facility, soil materials beneath the trenches were inspected for mercury. Soils containing mercury (visual inspection) were removed and later processed by the plant for reclamation of mercury.

The constituent of concern in the mercury cell room trenches is mercury. It was apparent during the reconstruction of the trenches in the early 1960's that wastewaters containing mercury migrated through cracks in the concrete to the soils below. However, visibly impacted soils were removed and the trenches reconstructed with reinforced gunite and sealed with an epoxy coating to eliminate seepage of mercury cell room wastewater to the subsoils.

13.5 Characterization of Release and Hazardous Constituents. As discussed in Section 5, the groundwater assessment findings in the area inclusive of the Mercury Cell Building over a five-year period have revealed plumes of elevated Hg, Cd, or Cl in groundwater (see plume maps on Figures 3-14 through 3-19 and Figure 5-4). The constituents which could be attributable to the cell room trench system are Hg and Cl. Reference to the plume maps shows that the Hg and Cl plumes in the plant process area are defined; the size and configuration of the plumes have not changed significantly during the five-year monitoring period. The nearest Deep Zone observation well (DOW-1) has shown no evidence of concern for Hg; elevated Cl values are observed (on the order of 4,500 to 5,000 mg/l, Table 3-10); however, downgradient Deep Zone wells (DOW-4, DOW-5, and DOW-6; see Figure 1-2) have shown significantly lower Cl values ranging from 10 to 200 mg/l (Table 3-10). The results of analyses of soil samples from borings B-8, and B-19 through B-25 (see Figures 3-7 and 3-8) show total Hg levels to be less than 1 mg/kg below depths of 2 to 5 feet. Four of these borings (B-22 through B-25, Figure 3-8) were adjacent to the Mercury Cell Building.

13.6 Potential Receptors. As a processing facility handling Hg, there is the ongoing risk of exposure that is dealt with by operating plans and safety precautions. With respect to groundwater, the only potential points of exposure would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to there being any measurable effect on the Tennessee River. Downgradient of the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. Based on the findings from these wells, there is no current groundwater concern associated with Hg, Cd, or Cl (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

<u>13.7 Conclusions and Proposed Investigations</u>. The results of the groundwater assessment work conducted during the past five years have defined the environmental setting, geology, hydrology, and groundwater flow patterns in the area of the Mercury Cell Building. The constituents of concern are known and so are the extent of constituents in groundwater in the vicinity of the Mercury Cell Building. Based on borings adjacent to the Mercury Cell Building, there appears to be limited infiltration of Hg into the soil profile beneath the Mercury Cell Building associated with the collection trench system. No additional sampling or analysis is proposed for this unit, other than continued monitoring of groundwater by the surrounding well clusters as provided for in the proposed site-wide groundwater monitoring program (Volume III). Accordingly, OxyChem believes that there is no reason to prepare an RFI report for this unit.

<u>13.7.1 Project Management Plan</u>. Not applicable.

<u>13.7.2 Sampling and Analysis Plan</u>. Not applicable.

<u>13.7.3 Data Management Plan</u>. Not applicable.

SECTION 14

RFI WORK PLAN - FORMER HYPALON-LINED STORAGE TANK LOCATION (SWMU 8) AND SOUTHERN STORMWATER DISCHARGE DITCH (SWMU 23)

14.1 General. A common RFI Work Plan has been prepared for the former Hypalon-Lined Storage Tank Location (SWMU 8) and the adjacent Stormwater Discharge Ditch (SWMU 23) - refer to Figures 1-4 and 1-5 for the SWMU locations.

Former Hypalon-Lined Storage Tank Location (SWMU 8). The former Hypalon-Lined Storage Tank (SWMU 8) was operated from 1976 to 1981 to temporarily store process wastewater from the Mercury Cell Room Trench System (SWMU 2). This unit was disassembled in 1983 and since there was no evidence of releases during its operation, no subsurface investigation was conducted at that time. The concentration of mercury in the stored process wastewater was not recorded, but historical information would suggest concentrations in the parts per million range.

Southern Stormwater Discharge Ditch (SWMU 23). The Southern Stormwater Discharge Ditch (SWMU 23) has continuously drained stormwater from the southern portion of the process area. This earthen drainage ditch originates near the former Hypalon-Lined Storage Tank location, drains to the low area described as the Stressed Vegetation Area (SWMU 24) south of the Former South Impounding Basin, and is routed roughly 300 feet to the south, discharging into the Stressed Vegetation Area (SWMU 24 on Figure 1-5). Prior to 1976, occasionally brine which accumulated in the closed-loop process system was discharged via this ditch. Currently, a portion of the process area stormwater runoff is drained via the Southern Stormwater Discharge Ditch raising concern for possible trace levels of Hg and Cl.

14.2 Previous Investigations. G&E's site-wide groundwater assessment provides considerable information about the former Hypalon-Lined Storage Tank Location and the Southern Stormwater Discharge Ditch. G&E's groundwater assessment activities in the vicinity of the former Hypalon-Lined Storage Tank area and Southern Stormwater Discharge Ditch included (1) a geophysical (electromagnetic conductivity) survey; (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells; (5) water level measurements; (6) groundwater sampling over a nearly five year period; (7) sampling of surface soils/sediments and surface water in the headwater region of the Southern Stormwater Discharge Ditch; and (8) analyses of soil, sediment, surface water, and groundwater.

Two soil exploration borings (B-13 [OW-28] and B-37, see Figure 3-6) were installed near the former Hypalon-Lined Storage Tank location. Three observation wells (Figure 1-2) are located in the vicinity of the former Hypalon-Lined Storage Tank; they include (by monitored zone):

- o Upper Zone: OW-27
- o Lower Zone: OW-28
- o Deep Zone: DOW-1

Five soil exploration borings (B-3 [OW-10A], B-13 [OW-28], B-14 [OW-38], B-38, and B-39, see Figure 3-6) were installed near the Southern Stormwater Discharge Ditch. Nine observation wells (see Figure 1-2) are located in the vicinity of the Souther Stormwater Discharge Ditch; they include (by monitored zone):

- o Upper Zone: OW-4, OW-9, OW-27, OW-37
- o Lower Zone: OW-10A, OW-28, OW-38
- o Deep Zone: DOW-1, DOW-5

Referring to Figure 3-20, surface soil samples (SS-1 through SS-8) and three surface water samples (SW-3, SW-5, and SW-7) were collected in the headwater area of the ditch (where it discharges to the low area identified as the Stressed Vegetation Area [SWMU

24] south of the former South Impounding Basin). Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor development, and groundwater sampling are provided as Appendix D of Volume I.

Geotechnical data, for the aforementioned borings in which soil samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near SWMU 8 and SWMU 23 are provided on analytical tests (Hg and Cl) soil profiles on Figures 3-7 and 3-8. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. Referring to Figure 3-1, a geophysical survey was conducted in the vicinity of the former Hypalon-Lined Storage Tank and Southern Stormwater Discharge Ditch. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters in the area of SWMU 8 are shown on Figures 3-2 through 3-5, respectively.

14.3 Environmental Setting. Located south of the OxyChem facility process area, the elevation of the former Hypalon-Lined Storage Tank Location is on the order of approximately 531 to 533 feet above mean sea level (see Plant Topographic Map, Figure 2-7). Site drainage from this area (see Figure 4-6) is to the Southern Stormwater Discharge Ditch. The Southern Stormwater Discharge originates at an elevation of approximately 530 feet above mean sea level and eventually falls off to an elevation of approximately 520 feet above mean sea level as it discharges into SWMU 24 (see Figure 2-7).

The aforementioned borings describe the stratigraphy underneath these units. The soil profiles shown on Figures 4-2 and 4-3 encompass the units. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is encountered at a depth of about 50 to 55 feet and 50 to 70 feet near the former Hypalon-Lined Storage Tank location and along the Southern Stormwater Discharge Ditch, respectively (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows in a southerly direction and southerly to westerly direction from the former Hypalon-Lined Storage Tank location and Southern Stormwater Discharge Ditch, respectively, while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of in-situ hydraulic conductivity tests (Table 3-4) in the vicinity of the former Hypalon-Lined Storage Tank location and beginning of the Southern Stormwater Discharge Ditch (in wells OW-27, OW-28, and DOW-1) were 3.2×10^{-5} cm/sec in the Upper Zone, 2.0×10^{-5} cm/sec in the Lower Zone, and 3.2×10^{-5} cm/sec in the Deep Zone.

14.4 Source Characterization. The former Hypalon-Lined Storage Tank served as temporary storage tank for process wastewater for approximately 6 years (1976 to 1981). The primary constituent of concern in the wastewater formerly stored in the Hypalon-Lined Storage Tank is Hg; Cl is a minor concern. There were no known releases from the tank.

The Southern Stormwater Discharge Ditch has continuously served as a stormwater discharge feature and occasionally prior to 1976 for the discharge of excess brine wastewater. The throughput and Cl concentration of brine process wastewater or process facility stormwater runoff entering the ditch is not known. The primary constituent of concern in the brine process water formerly discharged to the Southern Stormwater Discharge Ditch is Cl; Hg is a minor concern by virtue of its potential presence in facility process stormwater runoff received by the ditch; Cd is not a concern.

14.5 Characterization of Release and Hazardous Constituents. The results of the geophysical survey (see Figures 3-2 through 3-5) show slightly elevated conductivity values beneath the north portion of the Stressed Vegetation Area, believed to reflect the effects of former Cl sources in the plant process area (e.g. the salt piles and area precipitation basins). As discussed in Section 5, the groundwater assessment findings in the area inclusive of the Hypalon-Lined Storage Tank location and the Southern Stormwater Discharge Ditch over a five-year period have revealed plumes of elevated Hg, Cd, or Cl in groundwater (see plume maps on Figures 3-14 through 3-19 and Figure 5-4). Reference to the plume maps shows that the plumes in the plant process area are defined; the size and configuration of the plumes have not changed significantly during the five-year monitoring period. The nearest Deep Zone observation well (DOW-1) has shown no evidence of concern for Hg or Cd; elevated Cl values are observed (on the order of 4,500 to 5,000 mg/l, Table 3-10); however, downgradient Deep Zone wells (DOW-4, DOW-5, and DOW-6; see Figure 1-2) have shown significantly lower Cl values ranging from 10 to 200 mg/l (Table 3-10). There is, however, no reason to suspect that a release has occurred from the former Hypalon-Lined Storage Tank area or that there is a connection between the former tank and the above described groundwater impact.

The results of the eight surface soil and three surface water analyses (see Table 3-11) in the low area (SWMU 24) generally show de minimis levels of the constituents of concern (Hg, Cd, and Cl). Specifically, the range of total versus EP TOX constituent levels in the soil samples were:

Constituent	Total (mg/kg)	EP TOX (μg/l)
Hg	1.1 to 22	<0.2 to 0.7
Cd	<0.5 to 0.8	<10 to 10
Cl	<10 to 1,400	N/A

In the three water samples, the Hg levels ranged from <0.2 to 11 μg/l; Cd all were <5 μg/l; and Cl from 1,400 to 3,100 mg/l.

14.6 Potential Receptors. There are no surface or above-grade sources at the former facility; therefore, there will be no exposure potential associated with direct contact or inhalation of airborne constituents. With regard to groundwater, the only potential points of exposure would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to there being any measurable effect on the Tennessee River. Downgradient of the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. Based on the findings from these wells, there is no current groundwater exposure of Hg, Cd, or Cl to humans (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to hazardous constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has been and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

14.7 Conclusions and Proposed Investigations. The groundwater assessment work conducted during the past five years has defined the environmental setting, geology, hydrology, and groundwater flow patterns in the areas of the former Hypalon-Lined Storage Tank and Southern Stormwater Discharge Ditch. Constituents of potential concern associated with the tank and ditch are known based on process activities and the use of the tank and earthen ditch. The extent of constituents present in groundwater in the vicinity of the tank and earthen ditch is known, and there has been no evidence in the past five years of any significant effect on the environment or groundwater due to the former storage tank location or stormwater discharge ditch, with the exception of a historical stressed vegetation area (SWMU 24, addressed in Section 18). With the exception of a sediment sample and 20-foot deep boring adjacent to the Southern Stormwater Discharge Ditch and companion sediment sample, no additional investigation is proposed other than continued monitoring of groundwater by the array of observation wells to be included in the site-wide groundwater monitoring program (Volume III).

14.7.1 Project Management Plan. One soil boring and sediment sample is proposed for the Southern Stormwater Discharge Ditch at the location shown on Figure 14-1. The aforementioned wells surrounding the Former Hypalon-Lined Storage Tank location and Southern Stormwater Discharge Ditch will continue to be monitored for Hg, Cd, and Cl as part of the site-wide groundwater monitoring program for the Muscle Shoals facility. No RFI report is planned for the Former Hypalon-Lined Storage Tank location. The RFI report for the Southern Stormwater Discharge Ditch will present the newly and previously-accumulated data analyses, and will provide conclusions and recommendations specific to the stormwater discharge ditch. Engineers, geologists, or environmental specialists familiar with the site will perform the sampling, and will prepare the RFI report from new and existing information. Exploration boring installations will be performed by TTL, Inc. or Miller Drilling Company under the oversight of an experienced engineer or geologist. Analyses will be performed by SPL Laboratories in Lafayette, Louisiana. It is anticipated that the RFI report can be submitted within 120 days of notice of acceptance of the Work plan.

14.7.2 Sampling and Analyses Plan. One vehicular-mounted exploratory boring will be drilled utilizing hollow-stem drilling techniques and split-spoon samplers at the locations shown on Figure 14-1. Soil samples will be collected on two-foot centers to a depth of 20 feet; a ditch sediment sample (adjacent to the boring) will also be collected. The exploratory boring will be closed and abandoned by tremie grouting the borehole with a thick cement-bentonite mix. The soil samples will be analyzed for total and TCLP Hg and Cd and total Cl in accordance with the Sampling and Analysis Plan in Appendix A;

soil borings, soil sampling, and field measurements will also be accomplished in accordance with protocols presented in Appendix A. The soil and water analytical methodologies and detection limits are described in Appendix A.

14.7.3 Data Management Plan. Data records will be maintained which include the unique sample code; the sampling raw data; the sample location and type; the laboratory analysis ID number; the constituents analyzed for; and the results of the analyses. Field and analytical data collected in the course of the RFI will be organized and maintained in files. Tables will be prepared for geotechnical, geophysical, water level, and analytical data (organized by constituent). Figures based on the new and existing data will be presented in the RFI report to document findings and support conclusions and recommendations. Figures to be presented in the RFI report include site plans with sampling locations, constituent isopleth maps, potentiometric maps, and subsurface soil profiles.

SECTION 15

RFI WORK PLAN - MERCURY COLLECTION VESSEL (SWMU 10)

15.1 General. The Mercury Collection Vessel (SWMU 10 - see Figure 1-4) is an aboveground closed steel tank positioned on a concrete pad with concrete curb containment, located near the mercury retort tanks (SWMU 9). This vessel is located approximately 600 feet northwest of Waste Pile B. It was put into operation in 1988 and is presently an active unit.

The Mercury Collection Vessel collects and stores the mercury recovered from the operation of the mercury retort tanks. Any releases from this unit is contained within a concrete curbed area and enters the wastewater collection system through an inlet located inside the concrete area.

15.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the Mercury Collection Vessel. G&E's groundwater assessment activities in the vicinity of the unit included (1) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (2) completion of soil exploration borings as observation wells; (3) hydraulic conductivity testing of observation wells; (4) water level measurements; (5) groundwater sampling over a nearly five-year period; and (6) sampling and analyses of soil and groundwater.

By virtue of its location in the plant process area, the Mercury Collection Vessel is surrounded by borings and observation wells. The nearest borings to the vessel (Figure 3-6) are B-19 [OW-46], B-20 [OW-48], B-21 [OW-50], and B-22 through B-26. Seven observation wells (Figure 1-2) are located in the vicinity of the Mercury Cell Building; they include (by monitored zone):

- o Upper Zone: OW-47, OW-49, and OW-51
- o Lower Zone: OW-46, OW-48, and OW-50

o Deep Zone: DOW-1

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are provided in Appendix D of Volume I.

The geotechnical data, for the aforementioned borings in which soil samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near the Mercury Collection Vessel are provided on analytical tests (Hg and Cl) soil profiles on Figures 3-7 and 3-8. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively.

15.3 Environmental Setting. Located in the central portion of the OxyChem facility process area, the vessel is in a flat area with an approximate elevation of 529 feet above mean sea level (see Plant Topographic Map, Figure 2-7). Site drainage (see Figure 4-6) from the vessel area is to the wastewater drainage system and then to the NPDES Outfall Ditch. The curbed vessel area drains to the plant wastewater collection system.

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figures 4-2 and 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is encountered at a depth of about 48 to 50 feet (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows in a somewhat radial manner in a westerly direction from the Mercury Collection

Vessel, with mounding evident in the central portion of the plant process area, while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of in-situ hydraulic conductivity tests (Table 3-4) in the vicinity of the vessel, as interpreted from wells OW-48, OW-49, and DOW-1 were 4.7×10^{-4} cm/sec in the Upper Zone, 4.6×10^{-5} cm/sec in the Lower Zone, and 3.2×10^{-5} cm/sec in the Deep Zone.

15.4 Source Characterization. The Mercury Collection Vessel is a closed steel tank that collects and stores mercury recovered from operation of the mercury retort tanks. Releases from the tank via a pressure relief valve are minimal and would consist of water (with minimal Hg concentrations) which is received by the wastewater treatment system. There is no direct discharge of untreated, released water to the industrial sewer.

15.5 Characterization of Release and Hazardous Constituents. As discussed in Section 5, the groundwater assessment findings in the area inclusive of the Mercury Collection Vessel over a five-year period have revealed plumes of elevated Hg, Cd, or Cl in groundwater (see plume maps on Figures 3-14 through 3-19 and Figure 5-4). Reference to the plume maps shows that the plumes in the plant process area are defined; the size and configuration of the plumes have not changed significantly during the five-year monitoring period. The nearest Deep Zone observation well (DOW-1) has shown no evidence of concern for Hg or Cd; elevated Cl values are observed (on the order of 4,500 to 5,000 mg/l, Table 3-10); however, downgradient Deep Zone wells (DOW-4, DOW-5, and DOW-6; see Figure 1-2) have shown significantly lower Cl values ranging from 10 to 200 mg/l (Table 3-10). There is, however, no reason to suspect that a release has occurred from the vessel area or that there is a connection between the vessel and the above described groundwater impact.

15.6 Potential Receptors. As a closed vessel, and assuming no leaks or spills, there are no environmentally-related risks to receptors posed by the vessel.

15.7 Conclusions and Proposed Investigations. The results of the groundwater assessment work conducted during the past five years have defined the environmental setting, geology, hydrology, and groundwater flow patterns in the area of the Mercury Collection Vessel. There is no basis for suspecting the vessel of contributing to environmental concerns, i.e., the groundwater plumes. The vessel is closed and is positioned in a concrete curbed area. There are no reported spills or leaks associated with the vessel other than the aforementioned water releases that are received by the wastewater treatment system. Accordingly, there is no recommendation for sampling or analysis. The observation wells mentioned in Section 15.2 will continue to be sampled and analyzed for Hg, Cd, and Cl under the proposed groundwater program described in Volume III. OxyChem believes that there is no reason to prepare an RFI report for this unit.

15.7.1 Project Management Plan. Not applicable.

15.7.2 Sampling and Analysis Plan. Not applicable.

15.7.3 Data Management Plan. Not applicable.

SECTION 16

RFI WORK PLAN - SCRUBBER SOLUTION TREATMENT TANK (SWMU 13), OLD EAST OUTFALL DITCH (SWMU 15), AND GRAVEL AREAS ADJACENT TO ELECTRIC SUBSTATION (AOC C)

16.1 General. Three units are being addressed in a common RFI Work Plan due to their proximity to each other: the Scrubber Solution Treatment Tank (SWMU 13), the Old East Outfall Ditch (SWMU 15), and the Gravel Areas Adjacent to Electric Substation (AOC C). Their locations are shown on Figure 1-4.

Scrubber Solution Treatment Tank (SWMU 13): The scrubber solution treatment tank is a 55,000 gallon open-top steel tank unit located in the vicinity of the emergency chlorine scrubber tanks, approximately 400 feet northeast of Waste Pile B. The tank is underlain by a concrete pad. It was put into operation in 1974 and is presently an active unit. This process unit receives NaOCl solution from the emergency scrubber tanks. The NaOCl solution is treated with sodium sulfite to produce a NaCl and sodium sulfate wastewater stream, which is monitored under the plant's NPDES permit. A summary of DMR data for the unit is presented as Exhibit 16-1. The scrubber solution treatment tank discharges under permit into the Industrial Sewer System (SWMU 14).

Old East Outfall Ditch (SWMU 15): The Old East Outfall Ditch is approximately 600 feet long and runs from south to north. The most southerly point of this earthen drainage ditch is located approximately 100 feet north and 500 feet east of Waste Pile B. It was put into operation in 1953 and is presently an active unit. The outfall ditch receives treated wastewaters from the Industrial Sewer System and non-process stormwater runoff from the eastern side of the plant. The ditch discharges into the NPDES Outfall Ditch (SWMU 16).

Gravel Areas Adjacent To Electric Substation (AOC C): The gravel areas designated as AOC C are located approximately 450 feet northeast of Waste Pile B, south of the electrical substation building. During the RFA, the concern was raised that surface spills may have occurred in this area.

16.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the area around these three units. G&E's groundwater assessment activities in the vicinity of these units included (1) a geophysical (electromagnetic conductivity) survey; (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells; (5) water level measurements; (6) groundwater sampling over a nearly five year period; and (7) sampling and analyses of soil and groundwater.

Exploration borings (B-19 [OW-46] and B-36 [OW-60] are the borings nearest these three units. Nine observation wells (Figure 1-2) are located within approximately 500 feet of the three units; they include (by monitored zone):

- o Upper Zone: OW-11, OW-47, OW-54, OW-60
- o Lower Zone: OW-12A, OW-46, OW-58, OW-59
- o Deep Zone: DOW-1

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are provided as Appendix D of Volume I.

Geotechnical data, for the aforementioned borings in which soil samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near the three units are provided on analytical tests (Hg and Cl) soil profiles on Figures 3-7 and 3-8. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. Referring to Figure 3-1, a geophysical survey was conducted across the area where the three units are located. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters in the area of SWMU 3 are shown on Figures 3-2 through 3-5, respectively.

16.3 Environmental Setting. Located on the east side of the OxyChem facility process area, the three units are at elevation 524 to 527 feet above mean sea level (see Plant Topographic Map, Figure 2-7). The invert of the Old East Outfall Ditch is approximately 5 to 10 feet below grade. Site drainage from this area (see Figure 4-6) is to the Old East Outfall Ditch and then to the NPDES Outfall Ditch.

The aforementioned borings describe the stratigraphy underneath the units. The soil profiles shown on Figures 4-2 and 4-3 encompass the units. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is encountered at a depth of about 50 feet (see Figure 4-1).

In this area, the groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows in an easterly direction, while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of in-situ hydraulic conductivity tests (Table 3-4) conducted in wells OW-46, OW-47, and DOW-1 were 4.9×10^{-4} cm/sec in the Upper Zone, 3.4×10^{-5} cm/sec in the Lower Zone, and 3.2×10^{-7} cm/sec in the Deep Zone.

16.4 Source Characterization. Characterizations of each unit are presented below:

Scrubber Solution Treatment Tank (SWMU 13): In operation since 1974, the scrubber solution treatment tank receives scrubber solution (sodium hypochlorite) from the emergency chlorine scrubber tanks. Based on inputs from the chlorine scrubber tanks, the volume of treated wastewater materials handled by this unit is approximated at 15 tons per year. Sodium sulfite is added to the wastewater to produce a wastewater stream of NaCl and sodium sulfate for discharge (under permit) to the Industrial Sewer System. The constituents of concern in the scrubber solution wastewater have been assessed in compliance with the plant's NPDES Permit.

Old East Outfall Ditch (SWMU 15): During the period 1953 to the present, the Old East Outfall Ditch received all wastewater and stormwater runoff that exited the sewer outfalls along the eastern side of the plant. The volume of wastewater and stormwater runoff handled by this unit is not known.

The principal constituents of concern in the waters received by the ditch are mercury and chloride. Seepage loss from the ditch is possible since no liner or other release controls are employed in the operation of this unit.

Gravel Areas Adjacent to Electrical Substation (AOC C): The gravel areas adjacent to the electrical substation were cited during the RFA as possibly having been exposed to spills. The constituents of concern in the gravel areas are unknown because no releases have been documented at this unit.

16.5 Characterization of Release and Hazardous Constituents. The results of the conductivity survey in these areas show a relatively low conductivity response anomaly along the Old East Outfall Ditch (see Figures 3-2 through 3-5), perhaps related to infiltration of water containing elevated Cl concentrations. Referring to the plume maps (Hg, Cd, and Cl) shown on Figures 3-14 through 3-19 and Figure 5-4, the locations of the three units fall within the outer limits of the plumes. However, there is no known connection between the plumes and the three units.

16.6 Potential Receptors. There are no known surface or above-grade sources associated with the three units that would represent exposure potential associated with direct contact or inhalation of airborne constituents. With respect to groundwater (specifically, as might be influenced by infiltration from the Old East Outfall Ditch), the only potential points of exposure would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to there being any measurable effect on the Tennessee River. Downgradient of the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. Based on the findings from these wells, there is no current groundwater exposure of Hg, Cd, or Cl to humans (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to hazardous constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has been and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

16.7 Conclusions and Proposed Investigations. The results of the groundwater assessment work conducted during the past five years has defined the environmental setting, geology, hydrology, and groundwater flow patterns in the area encompassing the three areas of interest. Potential constituents of concern associated with the three areas are known or predictable based on unit activities and materials handled. The extent of principal constituents of concern present in groundwater in the vicinity is known, and there has been no evidence during the past five years of any significant effect on the environment or groundwater due to these constituents. Some additional investigation is recommended along with continued monitoring of groundwater by the array of observation wells to be included in the site-wide groundwater monitoring program (Volume III).

16.7.1 Project Management Plan. Limited sampling and analyses programs are proposed to address the three units as follows:

- o Scrubber Solution Treatment Tank (SWMU 13) - Sample and characterize effluent.

- o Old East Outfall Ditch (SWMU 15) - Drill and sample two borings to a depth of 20 feet at roughly one third intervals along the ditch length to investigate whether or not significant infiltration of constituents of concern has occurred. At the borehole locations, also collect a ditch sediment sample. Analyze samples for Hg, Cd, and Cl.

- o Gravel Areas Adjacent to Electric Substation (AOC C) - Collect a composite sample from two locations and analyze for Hg, Cd, Cl and polychlorinated biphenyls (PCBs).

The aforementioned wells in the area will continue to be monitored for Hg, Cd, and Cl (unfiltered samples) as part of the site-wide groundwater monitoring program for the Muscle Shoals facility. The RFI report will present the new and previously accumulated data and analyses, and will provide conclusions and recommendations specific to the three units. Engineers, geologists, or environmental specialists familiar with the site will perform the sampling, and will prepare the RFI report from new and existing information. Exploratory boring installations will be performed by TTL, Inc. or Miller Drilling Company under the oversight of an experienced engineer or geologist. Analyses will be performed by SPL Laboratories in Lafayette, Louisiana. It is anticipated that the RFI report can be submitted within 120 days of notice of acceptance of the Work Plan.

16.7.2 Sampling and Analysis Plan. Two vehicular-mounted exploratory borings will be drilled adjacent to the outfall ditch (SWMU 15) utilizing hollow-stem drilling techniques at the locations shown on the sampling plan included as Figure 16-1. Soil samples will be collected on five-foot centers to a depth of 20 feet; ditch sediment samples (adjacent to the borings) will also be collected. The exploratory borings will be closed and abandoned by tremie grouting the boreholes with a thick cement-bentonite mix. Boring soil and sediment samples will be analyzed for total and TCLP Hg and Cd and total Cl. Samples will be collected from two surficial soil sampling sites (beneath gravel covered areas; Figure 16-1 [AOC C]) and analyzed for total and TCLP Hg and Cd and total Cl. The samples will also be analyzed for TCLP PCBs. Data from previous investigations will be incorporated in the RFI report. The monitor wells listed in Section 16.2 will be sampled and analyzed in accordance with the Sampling and Analysis Plan in Appendix A; soil borings, soil sampling, and field measurements will also be accomplished in accordance with protocols presented in Appendix A. Soil and water analytical methodologies and detection limits are described in Appendix A.

16.7.3 Data Management Plan. Data records will be maintained which include the unique sample code; the sampling raw data; the sample location and type; the laboratory analysis ID number; the constituents analyzed; and the results of the analyses. Field and analytical data collected in the course of the RFI will be organized and maintained in files. Tables will be prepared for geotechnical, geophysical, water level, and analytical data (organized by constituent). Figures based on the new and existing data will be presented in the RFI report to document findings and support conclusions and recommendations. Figures to be presented in the RFI report include site plans with sampling locations, constituent isopleth maps, potentiometric maps, and subsurface soil profiles.

SECTION 17

RFI WORK PLAN - INDUSTRIAL SEWER SYSTEM (SWMU 14)

17.1 General. The Industrial Sewer System (SWMU 14) is a collection of lines (concentrated on the south side of the mercury cell building) that ring the plant process area, as shown on Figure 1-4. The original sewer system (concrete piping) was installed during plant construction in 1952. Most of the sewer lines installed at that time remain in use. A new line (vitrified clay) was installed in 1976 as part of the plant's wastewater treatment facility. A system of both overhead and underground lines was constructed between 1974 and 1980 to route the cell room trench waters either directly to the wastewater treatment system or to a 500,000-gallon holding tank.

17.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the Industrial Sewer System. Groundwater assessment activities in the vicinity of the Industrial Sewer System included (1) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (2) completion of soil exploration borings as observation wells; (3) hydraulic conductivity testing of observation wells; (4) water level measurements; (5) groundwater sampling over a nearly five-year period; and (6) sampling and analyses of soil and groundwater.

By virtue of its location in the plant process area, the Industrial Sewer System is surrounded by borings and observation wells. Thirteen exploration borings (B-8 [OW-12A], B-13 [OW-28], B-20 [OW-48], B-21 [OW-50], B-22 through B-28, B-35 [OW-58], and B-36 [OW-60], see Figure 3-6) were installed near the Industrial Sewer System. Thirteen observation wells (Figure 1-2) are located in the vicinity of the Industrial Sewer System; they include (by monitored zone):

- o Upper Zone: OW-11, OW-27, OW-49, OW-51, OW-59, and OW-61
- o Lower Zone: OW-12A, OW-28, OW-48, OW-50, OW-58, and OW-60
- o Deep Zone: DOW-1

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. Appendix D of Volume I includes the protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling.

Geotechnical data, for the aforementioned borings in which soil samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near the Industrial Sewer System are provided on analytical test (Hg and Cl) soil profiles on Figures 3-7 and 3-8. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively.

17.3 Environmental Setting. Located throughout the OxyChem facility process area, the Industrial Sewer System has a surface elevation of between 528 and 529 feet above mean sea level (see Plant Topographic Map, Figure 2-7). The invert depth of the sewer pipe ranges between 4 and 5 feet. Site drainage (see Figure 4-6) is principally governed by a system of shallow ditches in the area inclusive of the Industrial Sewer System. In the main portion of the plant, surface drainage is to the Industrial Sewer System. The balance is directed to stormwater ditches.

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figures 4-2 and 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is encountered at a depth of about 48 to 50 feet (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows radially from the Mercury Cell Building area, where mounding has occurred; while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of representative in-situ hydraulic conductivity tests (conducted in wells OW-27, OW-28, and DOW-1; see Table 3-4) are 3.2×10^{-5} cm/sec in the Upper Zone, 2.0×10^{-5} cm/sec in the Lower Zone, and 3.2×10^{-5} cm/sec in the Deep Zone.

17.4 Source Characterization. From 1952 to 1970 wastewater containing elevated levels of mercury and chloride (cadmium as a trace element of salt), including insoluble salts, from the mercury cell trenches (SWMU 7) and the brine processing area were discharged to the Old Outfall Ditch and the Original Pond Creek via the industrial sewer. Mercury was reportedly present in these discharges at levels of parts per million and salts were present at up to saturation levels and as suspended particles. The integrity of the joints between the sections of sewer pipe has been questionable and is believed to have resulted in constituent release from the sewer pipe.

17.5 Characterization of Release and Hazardous Constituents. As discussed in Section 5, the Industrial Sewer System is believed to be a contributor to the Hg, Cd, and Cl plumes nominally associated with former Waste Pile B. Plume maps (Hg, Cd, and Cl) presented on Figures 3-14 through 3-19 and Figure 5-4, show the Industrial Sewer System to be near the centroid of the plumes. The extent of the hazardous constituents Hg and Cd and non-hazardous constituent Cl has been defined. Groundwater impact associated with the Industrial Sewer System is an inextricable part of the aggregate impact of multiple former sources being addressed in terms of groundwater monitoring and corrective action under OxyChem's Part B Post-Closure permit application for former Waste Pile B submitted concurrently with this RFI Work Plan.

17.6 Potential Receptors. There are no surface or above-grade sources associated with the Industrial Sewer System; therefore, there will be no exposure potential associated with direct contact or inhalation of airborne constituents. From a groundwater standpoint, the only potential points of exposure would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to the Tennessee River. Downgradient of the Hg and Cd plumes, which are confined to the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. There is no current groundwater exposure of Hg, Cd, or Cl to humans at the TVA site (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to hazardous constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has been and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

17.7 Conclusions and Proposed Investigations. The assessment work conducted during the past five years has fully defined the environmental setting, geology, hydrology, and groundwater flow patterns in the vicinity of the Industrial Sewer System. Constituents of concern associated with the Industrial Sewer System are known based on process activities and use of the sewer system. The extent of constituents present in groundwater in the vicinity of the Industrial Sewer System is known, and there has been no evidence during the past five years of significant change in the constituent plumes. With the exception of continued monitoring of groundwater by the array of observation wells to be included in the site-wide groundwater monitoring program (Volume III), no additional investigation is proposed for the Industrial Sewer System, since the site-wide groundwater assessment over the past five years has defined the nature, extent, and significance of constituents of concern. Accordingly, OxyChem believes that there is no reason to prepare an RFI report for the Industrial Sewer System.

17.7.1 Project Management Plan. Not applicable.

17.7.2 Sampling and Analysis Plan. Not applicable.

17.7.3 Data Management Plan. Not applicable.

SECTION 18

RFI WORK PLAN - STRESSED VEGETATION AREA SOUTH OF FORMER SOUTH IMPOUNDING BASIN (SWMU 24)

18.1 General. This area of stressed vegetation (see Figure 1-5), located south of the former South Impounding Basin is referred to as SWMU 24. It is an approximate seven-acre site in a natural depression. This area was previously covered with trees and is now vegetated with aquatic species such as cattails and sedges. Occasionally, during the early 1970s, excess brine was directly discharged to the area via the Southern Stormwater Discharge Ditch (SWMU 23). Currently, only stormwater enters this feature and there has been a rebound in vegetative growth.

18.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the Stressed Vegetation Area south of the former South Impounding Basin. Groundwater assessment activities in the vicinity of the SWMU 24 included (1) a geophysical (electromagnetic conductivity) survey; (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells; (5) water level measurements; (6) groundwater sampling over a nearly five-year period; and (7) sampling and analyses of soil, groundwater, sediment, and surface water.

Four exploration borings (B-1 [OW-8A], B-2 [OW-6A], B-15 [OW-40], and B-33 [OW-54], see Figure 3-6) were installed in the vicinity of SWMU 24, and (referring to Figure 3-20) eight surface soil samples (SS-1 through SS-8) and three surface water samples (SW-3, SW-5, and SW-7) were collected within SWMU 24. Eleven observation wells (Figure 1-2) are located in the vicinity of SWMU 24; they include (by monitored zone):

- o Upper Zone: OW-5A, OW-7, OW-27, OW-39, and OW-55
- o Lower Zone: OW-6A, OW-8A, OW-28, OW-40, and OW-54
- o Deep Zone: DOW-1

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are provided in Appendix D of Volume I.

Geotechnical data, for the aforementioned borings in which soil samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near SWMU 24 are provided on analytical test (Hg and Cl) soil profiles on Figure 3-7. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities; groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. The analytical data for surface soil (sediment) samples and surface water samples in the SWMU 24 area are presented on Table 3-11. Referring to Figure 3-1, a geophysical survey was conducted in the vicinity of SWMU 24. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters in the area of SWMU 24 are shown on Figures 3-2 through 3-5, respectively.

<u>18.3 Environmental Setting</u>. Located in a naturally low flat area southwest of the OxyChem facility process area, SWMU 24 has an elevation of between 519 and 520 feet above mean sea level (see Plant Topographic Map, Figure 2-7). Area drainage is principally governed by the topography (see Figure 4-6) and is toward SWMU 24 and then to Pond Creek.

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figures 4-2 and 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is about 50 to 70 feet (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows in a southerly direction, while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of representative in-situ hydraulic conductivity tests in the vicinity of SWMU 24 (conducted in OW-7, OW-8A, and DOW-1; see Table 3-4) are 1.4×10^{-4} cm/sec in the Upper Zone, 1.0×10^{-3} cm/sec in the Lower Zone, and 3.2×10^{-5} cm/sec in the Deep Zone.

18.4 Source Characterization. The stressed vegetation area (SWMU 24) is characterized as an area impacted by previous discharges via the Southern Stormwater Discharge Ditch (SWMU 23) of brine waters. The effect of the brine waters was to kill fresh water species in the low area of SWMU 24. Review of historical photographs and inspection of current conditions at this area, reveals substantial rebounding of vegetation compatible with the saline surficial soil conditions.

The constituents of concern in this area are Hg and Cl. The extent and significance of these constituents in the SWMU 24 area were investigated by the aforementioned sampling program (see Figure 3-20 and Table 3-11).

18.5 Characterization of Release and Hazardous Constituents. The findings of the geophysical survey (Figures 3-2 through 3-5) show slightly elevated conductivity values beneath the northern portion of the stressed vegetation area believed to reflect the effects of former Cl sources in the plant process area (e.g., the salt piles and precipitation basins). The results of the eight surface soil and three surface water analyses (see Table 3-11) generally show de minimis levels of the constituents of concern (Hg, Cd, and Cl). Specifically, the ranges of total versus EP TOX constituent levels in the soil samples were:

Constituent	Total (mg/kg)	EP TOX (μg/l)
Hg	1.1 to 2.2	<0.2 to 0.7
Cd	<0.5 to 0.8	<10 to 10
Cl	<10 to 1,400	N/A

In the three water samples, the Hg levels ranged from <0.2 to 11 μg/l; Cd, all were <5 μg/l; and Cl, from 1,400 to 3,100 mg/l.

Plume maps (Hg, Cd, and Cl) presented on Figures 3-14 through 3-19 and Figure 5-4, show SWMU 24 to overlie a portion (all in the case of Cl) of the plumes. Groundwater impact associated with these plumes reflects the aggregate impact of multiple former sources in the plant process area moving downgradient and not SWMU 24. These plumes are being addressed in terms of groundwater monitoring and corrective action under OxyChem's Part B Post-Closure permit application for former Waste Pile B submitted concurrently with this RFI Work Plan.

18.6 Potential Receptors. There are no surface or above-grade sources associated with SWMU 24; therefore, there is no exposure potential associated with direct contact or inhalation of airborne constituents. With respect to groundwater, the only potential points of exposure to constituent plumes underlying SWMU 24 would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to the Tennessee River. Downgradient of the Hg and Cd plumes, which are confined to the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. There is no current groundwater exposure of Hg, Cd, or Cl to humans at the TVA site (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to hazardous constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has been and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

18.7 Conclusions and Proposed Investigations. The vegetation within SWMU 24 has shown clear evidence of rebound and will continue to rebound over time. The assessment work conducted during the past five years has fully defined the environmental setting, geology, hydrology, and groundwater flow patterns in the vicinity of SWMU 24. Constituents of concern associated with SWMU 24 are known based on process activities and use of the basin. The extent of constituents present in groundwater in the vicinity of the SWMU 24 is known, though the constituents are not believed to be attributable to SWMU 24, but rather former plant process areas. In any event, there has been no evidence during the past five years of significant change in the constituent plumes. Based on these findings, no additional investigation is proposed. However, the aforementioned observation wells will continue to be monitored in accordance with the proposed groundwater monitoring program (Volume III). Accordingly, OxyChem believes that there is no need for an RFI report for SWMU 24.

18.7.1 Project Management Plan. Not applicable.

18.7.2 Sampling and Analysis Plan. Not applicable.

18.7.3 Data Management Plan. Not applicable.

SECTION 19

RFI WORK PLAN - NPDES OUTFALL DITCH (SWMU 16) AND OLD TVA PIPELINE RIGHT-OF-WAY (AOC B)

19.1 General. A common RFI Work Plan has been prepared for the plant NPDES Outfall Ditch (SWMU 16) and the Old TVA Pipeline Right-of-Way (AOC B), since they parallel one another (see Figure 1-5).

NPDES Outfall Ditch (SWMU 16): The NPDES Outfall Ditch (SWMU 16) runs from east to west along the southern boundary of the former North Impounding Basin (SWMU 3). This earthen drainage ditch at its east end is approximately 1,200 feet northeast of Waste Pile B. It was put into operation in 1971 and is presently an active unit.

The NPDES Outfall Ditch receives flow entering at various points, beginning at the point of discharge of the Old East Outfall Ditch (SWMU 15). The NPDES Outfall Ditch receives treated wastewaters, non-process stormwater runoff, and wash water from tank and barge cleaning and chlorine storage tank cleaning operations.

Old TVA Pipeline Right-of-Way (AOC B): The Old TVA Pipeline Right-of-Way (TVA ROW) designated as AOC B is approximately 2,000 feet long by 30 feet wide. At its east end it is approximately 1,500 feet northwest of Waste Pile B, south of the former North Impounding Basin. It was put into operation at an unknown time and is presently an active unit.

Under TVA control, the area has been maintained devoid of vegetation to allow access to the pipeline. This has been achieved by the routine application to the area of chemicals (herbicides); this has reportedly occurred for decades.

19.2 Previous Investigations. G&E's site-wide groundwater assessment provides some information about the area inclusive of the NPDES Outfall Ditch and the TVA ROW.

Groundwater assessment activities inclusive of these two units included (1) a geophysical (electromagnetic conductivity) survey (north of the NPDES Outfall Ditch); (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells; (5) water level measurements; (6) groundwater sampling over a nearly five-year period; and (7) sampling and analyses of soil, groundwater, and surface water.

Four exploration borings (B-9 [OW-30], B-12 [OW-36], B-18 [OW-44], and B-35 [OW-58], see Figure 3-6) were installed and three surface water samples (SW-11, SW-12, and SW-13 see Figure 3-20 and Table 3-11) were collected near (or from) the two features. Nine observation wells (Figure 1-2) are located in the general vicinity of the NPDES Outfall Ditch and the Old TVA ROW; they include (by monitored zone):

- o Upper Zone: OW-29, OW-3, OW-45, OW-59
- o Lower Zone: OW-30, OW-36, OW-44, OW-58
- o Deep Zone: DOW-4

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are provided as Appendix D of Volume I.

Geotechnical data, for the aforementioned borings in which soil samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near the two features are provided on analytical test (Hg and Cl) soil profiles on Figure 3-7. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities; groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. The analytical data for surface water samples from the NPDES

Outfall Ditch are presented on Table 3-11. Referring to Figure 3-1, a geophysical survey was conducted in the area north of the NPDES Outfall Ditch. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters in the area are shown on Figures 3-2 through 3-5, respectively.

19.3 Environmental Setting. Located north and northwest of the OxyChem facility process area, the two subject features traverse areas with elevations of between 519 and 533 feet above mean sea level (see Plant Topographic Map, Figure 2-7). Site drainage (see Figure 4-6) is principally governed by the topography in the area and is directed to the NPDES Outfall Ditch.

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figures 4-2 and 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is about 45 to 65 feet (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows to the northwest while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of representative in-situ hydraulic conductivity tests in the vicinity of the two features (conducted in wells OW-29, OW-30, and DOW-4; see Table 3-4) are 2.9×10^{-4} cm/sec in the Upper Zone, 5.2×10^{-5} cm/sec in the Lower Zone, and 8.2×10^{-7} cm/sec in the Deep Zone.

19.4 Source Characterization.

NPDES Outfall Ditch (SWMU 16): During the period 1971 to the present, the NPDES Outfall Ditch has received approximately 8,000 to 12,000 gallons per minute (gpm) of treated wastewaters, non-process stormwater runoff, and wash water from tank and barge cleaning and chlorine storage tank cleaning operations. There is the potential for seepage of water into the subsurface soils, since the ditch is an unlined facility. The constituents of potential concern in the water of the NPDES ditch are Hg, Cd, and Cl.

Old TVA Pipeline Right-of-Way (AOC B): Over an extended, but unknown period of time, the TVA ROW has been exposed to surface applications of herbicide chemicals. These chemicals have been applied regularly by TVA for decades to maintain the area devoid of vegetation and provide access to the pipeline. The constituents of concern would be herbicides.

19.5 Characterization of Release and Hazardous Constituents. The findings of the geophysical survey (see Figures 3-2 through 3-5) showed a single, very localized and shallow conductivity anomaly in the immediate vicinity of the OW-29 and OW-30 well cluster (note the well cluster was installed to investigate the anomaly). Well OW-24 (Upper Zone well) has shown Cl values on the order of 1,500 mg/l, while the Lower Zone well (OW-30) has shown Cl values no greater than 200 mg/l since December 1988. Plume maps (Hg, Cd, and Cl) presented on Figures 3-14 through 3-19 and Figure 5-4, show the NPDES Outfall Ditch and the TVA ROW to be outside of the plumes. The results of ditch water sample analyses (SW-11, SW-12, and SW-13; see Table 3-11) for the NPDES Outfall Ditch showed 1.2 to 10.7 μg/l of Hg and 120 to 13,000 mg/l of Cl (note the high Cl sample [SW-11] was taken right at the ditch headwater region; further downstream values SW-12 and SW-13 were 160 mg/l and 120 mg/l of Cl, respectively). OxyChem intends to sample the NPDES Outfall Ditch and the TVA ROW to further define environmental conditions.

19.6 Potential Receptors. There are no known surface or above-grade sources connected with the two features; therefore, there is no anticipated exposure potential associated with direct contact or inhalation of airborne constituents. If groundwater in the areas of interest were of concern, the only potential points of exposure would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to the Tennessee River. Downgradient of the Hg and Cd plumes, which are confined to the Oxychem facility, the Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. There is no current groundwater exposure of Hg, Cd, or Cl (the constituents present in groundwater plumes elsewhere on the property) to humans at the TVA site (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to hazardous constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has been and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

19.7 Conclusions and Proposed Investigations. The assessment work conducted during the past five years has generally defined the environmental setting, geology, hydrology, and groundwater flow patterns in the vicinity of the NPDES Outfall Ditch and the old TVA ROW. Constituents of concern associated with these features are known based on process activities, wastewater discharge analyses, and land use. The extent of constituents present in groundwater in the vicinity of the two features is generally known, and there has been no evidence during the past five years of significant change. Additional investigation is, however, proposed to define the nature, extent, and significance of pertinent constituents in the immediate vicinity of the NPDES Outfall Ditch and TVA ROW.

19.7.1 Project Management Plan. The proposed additional investigation (see Figure 19-1) consists of (1) three soil exploration borings and associated ditch sediment samples along the NPDES Outfall Ditch (the borings adjacent to the ditch will be 20 feet deep or deeper to penetrate a minimum of 10 feet below the bottom of the ditch), (2) three shallow borings (5 feet deep) along the TVA ROW, (3) continued water level measurements and sampling and analysis of existing observation wells (included in the proposed site-wide groundwater monitoring program presented in Volume III).

The RFI report will present the new and previously-accumulated data and analyses, and will provide conclusions and recommendations specific to the NPDES Discharge Ditch and the TVA ROW. Engineers, geologists, or environmental specialists familiar with the site will perform the sampling, and will prepare the RFI report from new and existing information. Exploratory boring installations will be performed by TTL, Inc. or Miller Drilling Company under the oversight of an experienced engineer or geologist. Analyses will be performed by SPL Laboratories in Lafayette, Louisiana. It is anticipated that the RFI report can be submitted within 120 days of notice of acceptance of the Work Plan.

19.7.2 Sampling and Analysis Plan. Three vehicular-mounted exploratory borings will be drilled adjacent to the NPDES Outfall Ditch utilizing hollow-stem drilling techniques and split-spoon samplers. Soil samples will be collected on five-foot centers to the bottom of the boreholes; ditch sediment samples (adjacent to the borings) will also be collected. The exploratory borings will be closed and abandoned by tremie grouting the boreholes with a thick cement-bentonite mix. Soil samples will be collected and analyzed for total and TCLP Hg and Cd and for total Cl (see Appendix A for methodology and detection limit).

Three soil samples (3- to 5-foot depth, see Figure 19-1 for locations) will be taken along the TVA ROW using hollow-stem equipment and will be grouted upon completion.

These samples will be collected and analyzed for herbicides (see Appendix A for methodology and detection limit).

Data from previous investigations will be incorporated in the RFI report. The monitor wells listed in Section 19.2 will be sampled and analyzed in accordance with the Sampling and Analysis Plan in Appendix A; drilling, sampling, and field measurements will also be accomplished according to protocols contained in Appendix A.

19.7.3 Data Management Plan. Data records will be maintained which include the unique sample code; the sampling raw data; the sample location and type; the laboratory analysis ID number; the constituents analyzed; and the results of the analyses. Field and analytical data collected in the course of the RFI will be organized and maintained in files. Tables will be prepared for geotechnical, geophysical, water level, and analytical data (organized by constituent). Figures based on the new and existing data will be presented in the RFI report to document findings and support conclusions and recommendations. Figures to be presented in the RFI report include site plans with sampling locations, constituent isopleth maps, potentiometric maps, and subsurface soil profiles.

SECTION 20

RFI WORK PLAN - JUNKYARD (AOC A)

20.1 General. The area described in the RFA as a Junkyard (AOC A) is a used process equipment staging area (see Figure 1-5). The staging area is an abovegrade site encompassing 1 to 2 acres adjacent to the southeast corner of the North Impounding Basin. The area is approximately 1,200 feet north of former Waste Pile B. The date the area was originally used is not known, however, it is presently an active long term equipment storage unit.

20.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the staging area. Groundwater assessment activities in the vicinity included (1) a geophysical (electromagnetic conductivity) survey north and east of the area; (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells; (5) water level measurements; (6) groundwater sampling over a nearly five-year period; and (7) sampling and analyses of soil, groundwater, and sediment.

Four exploration borings (B-7 [OW-20A], B-10 [OW-32], B-18 [OW-44], and B-35 [OW-58], see Figure 3-6) were installed in the general area (within 800 feet), and three surface soil samples (samples 1-1-S, 2-2-S, and 4-2-S; see Exhibit 10-1, WCC report for the former North Impounding Basin) were collected along the north and east sides of the staging area. Eight observation wells (Figure 1-2) are located in the general vicinity of the staging area; they include (by monitored zone):

- o Upper Zone: OW-19, OW-31, OW-45, and OW-59
- o Lower Zone: OW-20A, OW-32, OW-44, and OW-58

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are included as Appendix D of Volume I.

Geotechnical data, for the aforementioned borings in which soil samples were subjected to geotechnical tests, and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near the staging area are provided on analytical test (Hg and Cl) soil profiles on Figures 3-7 and 3-8. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities; groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. The analytical data (EP TOX) for WCC shallow soil samples 1-1-S, 2-2-S, and 4-2-S are in Exhibit 10-1 and on Table 10-1. Referring to Figure 3-1, a geophysical survey was conducted in the vicinity of the staging area. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters are shown on Figures 3-2 through 3-5, respectively.

<u>20.3 Environmental Setting</u>. Located northeast of the OxyChem facility process area, the staging area has an elevation of between 526 and 528 feet above mean sea level (see Plant Topographic Map, Figure 2-7). Site drainage (see Figure 4-6), principally governed by the topography, flows into the NPDES Outfall Ditch (SWMU 16).

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figures 4-2 and 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is about 45 to 50 feet (see Figure 4-1).

The groundwater in the Upper and Lower Zones (Figures 3-11 and 3-12, respectively) flows in a northerly direction, while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest, which is the regional flow pattern in the vicinity of the plant (Figure 4-8). The results of in-situ hydraulic conductivity tests conducted in the nearest well cluster (OW-58 and OW-59; see Table 3-4) are 1.5×10^{-3} cm/sec in the Upper Zone and 1.3×10^{-3} cm/sec in the Lower Zone.

20.4 Source Characterization. For an undetermined period of time, the process equipment staging area has received a variety of used equipment and debris that was deemed valuable or reusable. The materials have not been formally tracked, and there are no storage or decontamination guidelines currently in place. There currently are no known constituents of potential concern or the release potentials in the staging area.

20.5 Characterization of Release and Hazardous Constituents. The findings of the geophysical survey (see Figures 3-2 through 3-5) show no significant conductivity anomalies in the staging area. The constituent plume maps (Hg, Cd, and Cl) presented on Figures 3-14 through 3-19 and Figure 5-4, show no significant impact to groundwater beneath the staging area. Interviews conducted with persons familiar with the staging area may produce useful information concerning this site. The results of the WCC sample analyses for EP TOX metals (see Table 10-1) show no levels of concern for Hg or Cd.

20.6 Potential Receptors. There are no known surface or above-grade sources of concern at the equipment staging facility; therefore, there will be no exposure potential associated with direct contact or inhalation of airborne constituents.

20.7 Conclusions and Proposed Investigations. The findings of the nearby geophysical survey, surface soil sample analyses, and groundwater sampling and analysis program over the past nearly five years give no indications of concern at the process equipment staging area. However, it is proposed, consistent with the RFA findings for this area, that

personnel interviews be conducted to assess historical use of the site and determine whether or not there are any sources of concern.

20.7.1 Project Management Plan. Not applicable, unless interviews with persons familiar with the historical use of this area (e.g. current and former employees) raise concerns that do not now exist.

20.7.2 Sampling and Analysis Plan. Not applicable, unless interviews with persons familiar with the historical use of this area (e.g. current and former employees) raise concerns that do not now exist. In such an event, an appropriate sampling and analysis plan will be prepared.

20.7.3 Data Management Plan. Not applicable, unless interviews with persons familiar with the historical use of this area (e.g. current and former employees) raise concerns that do not now exist. In such an event, an appropriate data management plan will be prepared.

SECTION 21

RFI WORK PLAN - OLD EAST DITCH (AOC D)

21.1 General. The Old East Ditch (AOC D), See Figure 1-5, originates on the east side of the plant area and runs a northeast course passing along the south side of the closed landfill and merging with surface drainage southeast of the closed landfill. The original purpose of the Old East Ditch is not certain, but probably collected stormwater runoff from the southeastern portion of the plant area, its current intended use.

21.2 Previous Investigations. G&E's site-wide groundwater assessment provides information about the Old East Ditch. G&E's groundwater assessment activities in the vicinity of the Old East Ditch included (1) a geophysical (electromagnetic conductivity) survey; (2) drilling and sampling soil exploration borings and geotechnical testing of soil samples; (3) completion of soil exploration borings as observation wells; (4) hydraulic conductivity testing of observation wells; (5) water level measurements; (6) groundwater sampling over a nearly five year period; and (7) sampling and analyses of soil, groundwater, surface water, and sediment.

Two soil exploration boring (B-5 [OW-14A], B-6 [OW-24A], see Figure 3-6) were installed in the vicinity of the Old East Ditch, and two surface soil (sediment) samples (SS-9, SS-10, see Figure 3-20) and two surface water samples (SW-9, SW-10, see Figure 3-20) were collected in the Old East Ditch. Five observation wells (Figure 1-2) are located in the vicinity of the Old East Ditch; they include (by monitored zone):

- o Upper Zone: OW-13, OW-23
- o Lower Zone: OW-14A, OW-24A
- o Deep Zone: DOW-2

Soil exploration boring logs and monitor well cross-section details are presented in Appendix A of Volume I and Appendix A of Volume III, respectively. The protocols used

for soil exploration borings, groundwater monitor well installations, monitor well development, and groundwater sampling are included as Appendix D to Volume I.

Geotechnical data and hydrogeological data for the aforementioned borings are included in Tables 3-1 and 4-2, respectively. The analytical results for soil borings installed near the Old East Ditch are provided on analytical tests (Hg and Cl) soil profiles on Figure 3-7. Table 3-4 summarizes the observation well details (depths, ground surface and top-of-casing elevations, screen intervals, and hydraulic conductivities). Groundwater analytical data for the observation wells are included on Tables 3-8, 3-9, and 3-10 for Hg, Cd, and Cl, respectively. The analytical data for surface water and surface sediment samples are presented on Table 3-11. Referring to Figure 3-1, a geophysical survey was conducted in the vicinity of the Old East Ditch. Geophysical response measurements for sounding depths of 6, 10, 20, and 40 meters in the area of Old East Ditch are shown on Figures 3-2 through 3-5, respectively.

21.3 Environmental Setting. Located east of the OxyChem facility process area, the Old East Ditch traverses and area of elevations ranging from 530 feet above mean sea level near the OxyChem east-west railroad spur to 524 feet above mean sea level where the ditch merges with the low area southeast of the Closed Landfill (see Plant Topographic Map, Figure 2-7). The ditch is as much as 6 to 8 feet deep at its west end. The ditch accepts drainage from the area east of the OxyChem facility and from the southeast face of the landfill.

The aforementioned borings describe the stratigraphy underneath the unit. The soil profiles shown on Figures 4-2 and 4-3 encompass the unit. The upper stratum (residuum) consists primarily of unstratified reddish-brown clay and silty clay, with varying amounts of chert, increasing with depth. The anticipated depth to the Tuscumbia limestone is 55 to 68 feet (see Figure 4-1).

In the vicinity of the Old East Ditch, the groundwater in the Lower and Upper Zones (Figures 3-11 and 3-12, respectively) flows in an easterly direction, while the groundwater in the Deep Zone (Figure 3-13) flows toward the west-southwest. The results of in-situ conductivity tests (Table 3-4) in the vicinity of the Old East Ditch vary significantly. The results of tests conducted in wells OW-24A and OW-23 were 6.9×10^{-4} cm/sec in the Upper Zone and 6.0×10^{-3} cm/sec in the Lower Zone. The results of tests conducted in wells OW-14A and OW-13 were 3.3×10^{-4} cm/sec in the Upper Zone and 8.1×10^{-5} cm/sec in the Lower Zone.

21.4 Source Characterization. The Old East Ditch is characterized as an unlined earthen drainage feature conveying stormwater runoff from the southeastern portion of the plant. The age of the ditch is not known, but is likely in excess of 30 years. Constituents of potential concern in the water conveyed by the ditch would be Hg and Cl by virtue of de minimis presence in runoff waters. Since the ditch is unlined, there is the potential for infiltration of constituents through the base of the ditch.

21.5 Characterization of Release and Hazardous Constituents. The findings of the geophysical survey (Figures 3-2 through 3-5) show minimal conductivity response; and the conductivity levels observed are likely to be more a reflection of the Closed Landfill than the Old East Ditch. The results of the two sediment soil and two ditch water analyses (see Table 3-11) are summarized below:

SEDIMENT SAMPLES

	Total (mg/kg)		EP TOX (µg/l)	
Constituent	SS-9	SS-10	SS-9	SS-10
Hg	0.3	2.0	<0.2	10
Cd	<0.5	0.8	<0.2	10
Cl	<10	2,850	N/A	N/A

DITCH WATER SAMPLES

Constituent	SW-9	SW-10
Hg	0.2 μg/l	33 μg/l
Cd	<5 μg/l	<5 μg/l
Cl	1,000 mg/l	3,200 mg/l

It is noted that sampling locations SS-10 and SW-10 were selected adjacent to the Closed Landfill where there was evidence of leaching from the landfill. The subsequent upgrading of the Closed Landfill has eliminated the leaching phenomenon. Otherwise, i.e., based on the results of analyses of samples SS-9 and SW-9, there is no significant constituent level, except Cl at 1,000 mg/l. Subsequent to this sampling event (May 1989), the salt piles were removed, eliminating the runoff from which is believed to have contributed to the elevated Cl.

Reference to the Hg and Cl soil analyses profiles for borings B-5 (OW-14A) and B-6 (OW-24A) show low total Hg concentrations (≤0.05 mg/kg in OW-14A and <0.24 mg/kg in OW-24A); Cl levels were also low (<300 mg/kg in OW-14A and <200 mg/kg below a depth of 5 feet in OW-24A).

Plume maps (Hg, Cd, and Cl) presented on Figure 3-14 through 3-19 and Figure 5-4, while in some instances inclusive of the Old East Ditch, are believed to principally represent the effects of the Closed Landfill.

21.6 Potential Receptors. There are no surface or above-grade sources involved with the Old East Ditch; therefore, there will be no exposure potential associated with direct contact or inhalation of airborne constituents. With regard to groundwater, the only potential points of exposure would be humans exposed to well water or to water drawn from Tuscumbia Springs; these exposure sites would be impacted prior to there being any measurable effect on the Tennessee River. Downgradient of the Oxychem facility, the

Tennessee Valley Authority (TVA) Research and Development Center intercepts the groundwater flowing across the OxyChem facility. At the TVA site, there are abandoned irrigation wells and a network of groundwater monitoring wells for their own RCRA and CERCLA waste sites. Based on the findings from these wells, there is no current groundwater exposure of Hg, Cd, or Cl to humans (see Appendix B of the May 1989 G&E report for monitor well analyses). The possibility of new wells being constructed and subsequent exposure is unlikely due to the controlled nature of the area and the TVA's use of the Tennessee River reservoirs for drinking water.

The only potential point of exposure in the environment to hazardous constituents associated with the OxyChem plant is the aquatic life of the Pickwick Reservoir. Extensive and continuous evaluation of the Pickwick Reservoir (TVA Technical Report Series: TVA/ONRED/AWR-86/14, 33, 36, 38, 42, 43, 44, 45, 46, and AWR-87/20) including its water and the tissues of its inhabitants has been and is being conducted by the TVA. TVA has concluded that there is no problem associated with Hg, Cd, or Cl.

21.7 Conclusions and Proposed Investigations. The assessment work conducted during the past five years has defined the environmental setting, geology, hydrology, and groundwater flow pattern in the vicinity of the Old East Ditch. Based on available data, there does not appear to be a significant concern associated with the Old East Ditch. However, it is proposed that two borings be drilled and sampled adjacent to the ditch (20 feet deep or deeper to sample the soil profile at least 10 feet below the bottom of the ditch) and companion ditch sediment samples be taken at the locations shown on Figure 21-1.

21.7.1 Project Management Plan. The aforementioned wells (Section 21.2) in the area will continue to be monitored for Hg, Cd, and Cl as part of the proposed site-wide groundwater monitoring program for the Muscle Shoals facility discussed in Volume III. The RFI report will present the new and previously accumulated data and analyses, and will provide conclusions and recommendations specific to the Old East Ditch.

Engineers, geologists, or environmental specialists familiar with the site will perform the sampling, and will prepare the RFI report from new and existing information. Exploratory boring installations will be performed by TTL, Inc. or Miller Drilling Company under the oversight of an experienced engineer or geologist. Analyses will be performed by SPL Laboratories in Lafayette, Louisiana. It is anticipated that the RFI report can be submitted within 120 days of notice of acceptance of the Work Plan.

21.7.2 Sampling and Analysis Plan. Two vehicular-mounted exploratory borings will be drilled adjacent to the Old East Ditch utilizing hollow-stem drilling techniques and split-spoon samplers at the locations shown on Figure 21-1. Soil samples will be collected on five-foot centers to the bottom of the borings; ditch sediment samples (adjacent to the borings) will also be collected. The exploratory borings will be closed and abandoned by tremie grouting the boreholes with a thick cement-bentonite mix. Boring and sediment soil samples will be analyzed for total and TCLP Hg and Cd, total Cl, and TCLP polychlorinated biphenyls (PCBs). Data from previous investigations will be incorporated in the RFI report. The monitor wells will be sampled and analyzed in accordance with the Sampling and Analysis Plan in Appendix A; soil borings, soil sampling, and field measurements will also be accomplished in accordance with protocols presented in Appendix A. Soil and water analytical methodologies and detection limits are presented in Appendix A.

21.7.3 Data Management Plan. Data records will be maintained which include the unique sample code; the sampling raw data; the sample location and type; the laboratory analysis ID number; the constituents analyzed; and the results of the analyses. Field and analytical data collected in the course of the RFI will be organized and maintained in files. Tables will be prepared for geotechnical, geophysical, water level, and analytical data (organized by constituent). Figures based on the new and existing data will be presented in the RFI report to document findings and support conclusions and recommendations. Figures to be presented in the RFI report include

site plans with sampling locations, constituent isopleth maps, potentiometric maps, and subsurface soil profiles.

SECTION 22
OFFSITE AREA - POND CREEK

22.1 General. Pond Creek was identified as neither a SWMU nor an AOC but rather an offsite area of interest. While an RFI work plan has not been prepared, OxyChem intends to conduct sampling and analyses as described in this section and to report the findings to USEPA and ADEM. The RFA report expressed interest in the relationship between the OxyChem plant and Pond Creek, which flows south to north on the west side of the OxyChem plant and Wilson Dam Road. OxyChem proposes to drill and sample two soil exploration borings adjacent to the creek and take a creek sediment sample at each borehole location. The sampling sites are shown on Figure 22-1 and were selected to provide the clearest picture of potential effect on the creek due to the OxyChem facility. Specifically, the sampling sites are positioned immediately upstream (south) and downstream (north) of where the plant NPDES Outfall enters the creek.

22.2 Sampling and Analysis Program. Two vehicular-mounted exploratory borings will be drilled utilizing hollow-stem auger techniques and split-spoon samplers at the locations shown on Figure 22-1. Soil samples will be collected on five-foot centers to the bottom of each boring (20 feet or deeper so as to sample at least 10 feet below the bottom of the creek). Creek sediment samples will be collected at the borehole locations. The exploratory borings will be closed and abandoned by tremie grouting the boreholes with a thick cement-bentonite mix. The soil and sediment samples will be analyzed for total and TCLP Hg and Cd, total Cl, and TCLP PCBs using the analytical methodologies and detection limits presented in Appendix A. Drilling, sampling, and field measurement protocols to be followed are also included in Appendix A. Engineers, geologist, or environmental specialists familiar with the site will perform the sampling, and will prepare the report from the acquired data and existing information. Exploratory boring installations will be performed by TTL, Inc. or Miller Drilling Company under the oversight of an experienced engineer or geologist. Analyses will be performed by SPL Laboratories in Lafayette, Louisiana.

22.3 Evaluation and Report. OxyChem will review and evaluate the findings of the proposed sampling and analysis program and submit a letter report to USEPA and ADEM. It is anticipated that the report can be submitted within 120 days of notice to proceed.

TABLE 1-1
RCRA FACILITY ASSESSMENT
SWMU/AOC SUMMARY

	Solid Waste Management Unit (SWMU)	Type of Unit	Years in Operation	RFI Work Plan	No Further Action
1	Landfill	Landfill	1955-1980	X	
2	Former South Impounding Basin	Surface Impoundment	1970-1976	X	
3	Former North Impounding Basin	Surface Impoundment	1970-1971	X	
4	Salt Storage Piles	Bulk Product Storage	1953-1991	X	
5	Brine Filter Backwash Collection Tank	Tank	1990-present		X
6	Sludge Pads	Waste Storage Area	1953-present	X	
7	Mercury Cell Room Trench System	Trenches/sump	1953-present	X	
8	Former Hypalon-Lined Storage Tank Location	Tank	1976-1981	X	
9	Mercury Retort Tanks	Tanks	1988-present		X
10	Mercury Collection Vessel	Tanks	1988-present	X	
11	Hazardous Waste Roll-Off Pad	Storage Pad	1985-present		X
12	Emergency Chlorine Scrubber Tanks	Tanks	1974-present		X
13	Scrubber Solution Treatment Tanks	Tanks	1974-present	X	
14	Industrial Sewer System	Sewer System	1953-present	X	
15	Old East Outfall Ditch	Ditch	1953-present	X	
16	NPDES Outfall Ditch	Ditch	1971-present	X	
17	Wastewater Treatment Frame Filter Presses	Filters	1974-present		X
18	Former PCB Storage Area	Temporary Storage	1980-1987		X
19	500,000-gallon Wastewater Storage Tank	Tank	1981-present		X
20	Wastewater Treatment Hydrazine Reaction Tank	Tank	1974-present		X
21	Wastewater Treatment Carbon Polishing Towers	Tank	1974-present		X
22	Carbon Tetrachloride Stripper	Tank	1956-present		X
23	Southern Stormwater Discharge Ditch	Ditch	Unknown-present	X	
24	Stressed Vegetation Area South of Former South Impounding Basin	Discharge Area	Unknown-present	X	
25	Waste Pile Storage Areas	Waste Piles (A and B)	1980-1984		X
	Area of Concern (AOC)				
A	Junkyard	Storage Area	Unknown-present	X	
B	Old TVA Pipeline Right-of-Way	Right-of-Way	Unknown-present	X	
C	Gravel Areas Adjacent to Electrical Substation	Surface Spill	Unknown-present	X	
D	Old East Ditch	Earthen Ditch	Unknown	X	
	Offsite Area				
	Pond Creek	Creek	1953 - Present	X	

TABLE 2-1
WATER WELLS IN THE VICINITY
Page 1 of 2

Well Number	Depth (ft)	Use/Status*
WW-1	90	Closed
WW-2	87	Closed
WW-3	91	Closed
COL-1	257	USGS Survey Well
RW-1	87	Closed
TVA-1	62	Irrigation (Inactive)
TVA-2	80	Irrigation (Inactive)
1	Unknown	Domestic (Inactive)
2	75	Domestic (Inactive)
3	153	Industrial
4	74	Domestic
5	293	Domestic
6	85	Domestic
7	178	Public
8	62	Public
9	120	Domestic
10	330	Industrial (Inactive)
11	283	Industrial
12	164	Domestic
13	72	Domestic
14	Unknown	U.S. Gov. (Inactive)
15	90	Irrigation
16	165	Public
17	170	Industrial
18	181	Industrial (Inactive)
19	189	Industrial
20	91	Industrial
21	119	Industrial
22	102	Domestic
23	100	Domestic
24	Unknown	Domestic
25	111	Domestic
26	121	Domestic
27	104	Domestic
28	Unknown	Domestic
29	111	Domestic
30	82	Domestic
31	100	Domestic
32	45	Domestic
33	200	Public
34	130	Domestic (Inactive)
35	95	Domestic
36	70	Domestic

TABLE 2-1
WATER WELLS IN THE VICINITY

Well Number	Depth (ft)	Use/Status*
37	170	Domestic
38	118	Domestic
39	100	Domestic
40	81	Domestic
41	81	Domestic
42	142	Domestic
43	61	Government (Inactive)
44	130	Domestic
45	59	Government (Inactive)
46	60	Domestic
47	180	Domestic
48	159	Domestic
49	117	Domestic
50	Unknown	Domestic
51	250	Industrial
52	250	Industrial
53	250	Industrial
54	250	Industrial
55	250	Industrial
56	250	Industrial
57	250	Industrial (Inactive)
58	250	Industrial
59	43	Domestic
60	114	Domestic
61	38	Domestic
62	225	Domestic (Inactive)
63	84	Domestic
64	43	Domestic
65	192	Domestic
66	Unknown	Domestic
67	Unknown	Domestic
68	69	Domestic (Inactive)
69	115	Domestic
70	96	Domestic
71	99	Domestic
72	245	Domestic
73	162	Public (School)
74	135	Domestic
75	88	Domestic
76	170	Domestic

*Active status unless otherwise indicated

TABLE 2-2
PREVIOUS INVESTIGATIONS
MUSCLE SHOALS CHLOR-ALKALI FACILITY

INVESTIGATOR	DATE OF INVESTIGATION	PURPOSE OF INVESTIGATION	SCOPE OF WORK
White Engineering, Inc.	1979	1) Surface flow control system design 2) Landfill clay cap design	1) Separate North Impounding Basin from the industrial sewer and surface runoff 2) Prepare plans for clay cap for landfill
Woodward-Clyde Consultants, Inc.	1980	1) Establish site groundwater flow patterns in land fill area 2) Determine impact of landfill on pond creek	1) Installation of 4 observation wells and 18 piezometers
Woodward-Clyde Consultants, Inc.	1980	1) Determine clay cap thickness in landfill area	1) Installed 19 borings through landfill cap and conducted permeability tests
Woodward-Clyde Consultants, Inc.	1981	1) Determine impact of North Impounding basin on the environment	1) Conducted surface sampling program of the sediments throughout the former North Impounding Basin
Woodward-Clyde Consultants, Inc.	1981	1) Define the limestone groundwater regime 2) Establish the extent, if any, of contamination from the landfill	1) Installation of 21 observation wells
Dames and Moore, Inc.	1987	1) Evaluate conditions of the Woodward-Clyde installed observation wells 2) Evaluate condition of landfill 3) Determine the landfill's possible role as a contamination source	1) Inspect the condition of existing observation wells 2) Measure water levels 3) Collect groundwater samples 4) Inspect landfill area
G&E Engineering, Inc.	1989	1) Conduct groundwater assessment - Define the source and extent of elevated mercury, cadmium, and chloride concentrations in the soil and groundwater beneath the site	1) Review previous investigations 2) Install additional observations wells 3) Collect soil and groundwater samples 4) Measure water levels
G&E Engineering, Inc.	1990	1) Supplement 1989 Groundwater Assessment - determine the hydrogeologic relationship between the soil profile and fractured limestone underlying the plant	1) Install additional deep observation wells 2) Measure water levels 3) Collect soil and groundwater samples 4) Conduct dye-tracing study

TABLE 3-1
GEOTECHNICAL DATA SUMMARY
Page 1 of 2

Well ID	Boring No.	Depth	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Dry Density	% Passing No. 200
OW-6A	B-2	0 - 2	15	37	15	21		87
		13 - 15						88
		48 - 50	50					25
OW-8A	B-1	0 - 2	21	30	23	7		92
		18 - 20	23	44	28	16		80
OW-10A	B-3	0 - 2	12	26	8	18		92
		28 - 30						78
		46 - 48	33		31			36
OW-12A	B-8	0 - 2	18	52	18	34		83
		8 - 10						77
		18 - 20						80
		23 - 25	40	90	38	52		28
OW-14A	B-5	0 - 2	17	45	16	29		90
		13 - 15	29	73	39	33		40
		53 - 55	26	62	32	31		46
OW-20A	B-7	0 - 2	19	50	26	24		89
		48 - 50	34	93	26	67		99
OW-24A	B-6	0 - 2	32	33	23	10		94
		28 - 30						78
		63 - 65	41	64	34	31		80
OW-26	B-4	0 - 2	21	41	20	21		93
		23 - 25						37
		38 - 40	34	94	45	50		29
OW-28	B-13	0 - 2	14	36	19	17		64
		48 - 50						52
OW-30	B-9	0 - 2	16	26	17	9		87
		18 - 20	31	88	32	56		68
		33 - 35						66
OW-32	B-10	0 - 2	17	45	19	26		96
		38 - 40						75
		58 - 60	40	65	25	39		54
		68 - 70						27

TABLE 3-2
SOIL SAMPLE ANALYTICAL DATA (B-35, B-36, B-37, B-40, B-41, B-42)
PAGE 1 OF 3

Boring B-35

Depth (ft)	Total Hg (µg/kg)	EP Tox Hg µg/ℓ	Total Cd (µg/kg)	EP Tox Cd µg/ℓ	Total Cl (mg/kg)
4	44	ND	2,600	1.2	16.5
9	26	ND	2,300	0.2	10.1
14	36	ND	1,700	0.3	12.1
19	74	ND	1,900	0.2	16.3
25	78	ND	2,000	0.2	4.2
29	72	ND	2,000	0.1	3.2
34	70	ND	1,900	0.3	2.6
39	35	ND	1,700	ND	5.6
44	18	ND	1,800	0.4	5.0
49	33	ND	3,000	0.6	15.7

Boring B-36

Depth (ft)	Total Hg (µg/kg)	EP Tox Hg µg/ℓ	Total Cd (µg/kg)	EP Tox Cd µg/ℓ	Total Cl (mg/kg)
3	67	ND	2,500	0.3	2.4
4	50	ND	2,700	0.3	6.6
9	69	ND	2,600	0.4	46.1
14	91	ND	2,500	0.4	23.8
19	90	ND	2,500	0.2	195.0
25	60	ND	2,100	1.6	338.0
29	64	ND	3,700	ND	379.0
34	55	ND	2,600	0.2	184.0
39	88	ND	2,800	0.6	48.0
44	13	ND	4,200	0.3	26.2
49	17	ND	2,800	1.1	38.1

Note: 1) ND = Below Detection Limit (<0.2 µg/ℓ for Hg and <0.1 µg/ℓ for Cd)

TABLE 3-2
SOIL SAMPLE ANALYTICAL DATA (B-35, B-36, B-37, B-40, B-41, B-42)
PAGE 2 OF 3

Boring B-37

Depth (ft)	Total Hg (µg/kg)	EP Tox Hg (µg/l)	Total Cd (µg/kg)	EP Tox Cd (µg/l)	Total Cl (mg/kg)
3	25,200	3.2	2,500	0.2	269
4	42,100	219.0	2,200	2.0	92.7
9	12,500	78.4	2,400	0.7	169
14	1,470	1.6	2,700	0.3	173
19	109	0.4	3,000	1.7	4,740
24	125	0.4	3,000	1.2	5,240
29	242	0.5	2,300	0.9	6,720
34	108	0.2	2,200	1.0	4,810
39	118	0.5	2,900	0.8	6,340
44	124	0.2	1,700	0.6	1,160
49	51	ND	2,600	0.5	669

Boring B-40

Depth (ft)	Total Hg (µg/kg)	EP Tox Hg (µg/l)	Total Cd (µg/kg)	EP Tox Cd (µg/l)	Total Cl (mg/kg)
4	10,100	10.5	3,000	ND	1,430
9	830	2.3	2,600	ND	2,250
14	426	6.5	3,500	0.2	3,530
19	343	7.1	3,900	0.9	4,320
24	294	1.8	2,500	0.3	5,440
29	278	1.4	2,100	2.1	2,930
34	293	1.2	2,700	0.4	3,030
39	385	4.0	2,800	0.3	3,320
44	312	0.8	2,700	3.9	2,520

Note: 1) ND = Below Detection Limit (<0.2 µg/ℓ for Hg and <0.1 µg/ℓ for Cd)

TABLE 3-2
SOIL SAMPLE ANALYTICAL DATA (B-35, B-36, B-37, B-40, B-41, B-42)
PAGE 3 OF 3

Boring B-41

Depth (ft)	Total Hg (µg/kg)	EP Tox Hg (µg/l)	Total Cd (µg/kg)	EP Tox Cd (µg/l)	Total Cl (mg/kg)
4	6,740	8.8	7,300	0.5	727
9	480	1.0	3,200	0.4	1,970
14	81	1.2	2,200	0.4	3,290
19	315	5.5	3,200	0.1	5,220
24	642	7.0	3,300	0.3	5,300
29	482	4.3	2,000	0.1	3,280
34	863	4.8	2,700	0.2	3,910
39	1,590	10.1	2,400	0.2	2,350

Boring B-42

Depth (ft)	Total Hg (µg/kg)	EP Tox Hg (µg/l)	Total Cd (µg/kg)	EP Tox Cd (µg/l)	Total Cl (mg/kg)
3*	27,100	2.6	5,700	ND	27.4
4	2,900	ND	2,900	ND	60.4
9	239	ND	3,900	ND	103
14	175	1.3	4,100	0.9	2,710
19	228	3.4	2,800	0.3	2,490
24	984	7.5	3,100	0.2	5,010
29	679	4.2	2,600	0.3	1,950
34	234	ND	2,900	0.4	311
39	85	ND	2,900	0.5	424
44	171	ND	2,700	0.5	611

Note: 1) ND = Below Detection Limit (<0.2 µg/ℓ for Hg and <0.1 µg/ℓ for Cd)

TABLE 3-3
BACKGROUND SOIL ANALYSIS (COMPOSITE B-38 AND B-39)
(SAMPLE ID 0188-S-1)
ANALYTICAL RESULTS

Cadmium	3,600 µg/kg
Mercury	78 µg/kg
Sodium	1,100,000 µg/kg
Chloride	23,100 µg/kg

Note: Soil sample was a composite of soils taken from borings B-38 and B-39.

TABLE 3-4
SUMMARY OF OBSERVATION WELL DETAILS
(Page 1 of 2)

Well ID	Date Installed	Depth (ft.)	Ground Surface Elevation (ft. MSL)	Top-of-Casing Elevation (ft. MSL)	Screen Interval Elevation (ft. MSL)	Hydraulic Conductivity (cm/sec)
Upper Zone Wells						
OW-1	9/80	38.00	533.71	534.93	495.04 to 485.04	5.1×10^{-5}
OW-2	9/80	39.00	522.29	524.59	483.18 to 473.18	7.0×10^{-5}
OW-3	9/80	38.00	519.25	521.80	483.99 to 473.89	1.22×10^{-5}
OW-4	9/80	38.00	525.12	526.06	488.19 to 478.19	8.2×10^{-5}
OW-5A	4/88	25.75	527.65	530.92	506.90 to 502.90	2.11×10^{-5}
OW-7	1/81	31.50	521.98	525.39	496.70 to 491.70	1.39×10^{-4}
OW-9	1/81	28.80	521.14	524.39	497.30 to 492.30	3.79×10^{-4}
OW-11	1/81	24.90	527.52	527.09	507.40 to 502.40	9.62×10^{-4}
OW-13	1/81	34.20	531.44	534.57	503.10 to 497.10	3.32×10^{-4}
OW-15A	2/81	37.00	528.10	530.66	497.10 to 491.10	2.21×10^{-5}
OW-15B	1/81	29.20	528.07	531.07	504.70 to 498.70	2.21×10^{-5}
OW-19	1/81	30.00	523.11	526.02	499.10 to 493.10	1.84×10^{-4}
OW-21	2/81	15.20	519.82	523.52	510.60 to 504.60	2.54×10^{-5}
OW-23	1/81	14.50	520.80	524.50	512.20 to 506.20	6.92×10^{-4}
OW-25	4/88	26.95	531.38	534.17	510.38 to 504.38	3.46×10^{-4}
OW-27	4/88	28.25	532.88	535.98	508.16 to 504.16	3.20×10^{-5}
OW-29	4/88	25.50	523.61	523.27	503.11 to 499.11	2.86×10^{-4}
OW-31	4/88	31.00	522.50	521.89	496.56 to 492.56	1.0×10^{-5}
OW-33	4/88	28.00	522.76	522.66	499.76 to 495.76	1.17×10^{-5}
OW-37	7/88	30.33	524.78	524.54	499.45 to 495.45	1.67×10^{-4}
OW-39	7/88	30.33	521.21	524.08	495.88 to 490.88	5.99×10^{-4}
OW-41	7/88	51.00	540.09	543.26	494.09 to 490.09	2.5×10^{-4}
OW-43	7/88	39.50	520.85	523.92	486.35 to 482.35	2.7×10^{-4}
OW-45	9/88	34.50	521.92	524.36	492.42 to 488.42	1.03×10^{-4}
OW-47	10/88	30.00	527.80	530.63	502.80 to 498.80	4.91×10^{-4}
OW-49	10/88	25.25	528.57	528.50	508.32 to 504.32	4.73×10^{-4}
OW-51	10/88	25.00	528.64	531.06	508.64 to 504.64	3.2×10^{-4}
OW-53	12/88	29.50	523.99	526.50	498.99 to 494.99	1.13×10^{-5}
OW-55	12/88	30.00	525.77	528.49	500.77 to 496.77	7.43×10^{-4}
OW-57	12/88	30.00	524.25	526.78	499.25 to 495.25	1.33×10^{-4}
OW-59	01/92	24.00	527.22	527.03	513.22 to 503.22	1.46×10^{-3}
OW-61	01/92	23.94	527.14	526.90	513.14 to 503.14	2.04×10^{-3}

TABLE 3-4
SUMMARY OF OBSERVATION WELL DETAILS
(Page 2 of 2)

Well ID	Date Installed	Depth (ft.)	Ground Surface Elevation (ft. MSL)	Top-of-Casing Elevation (ft. MSL)	Screen Interval Elevation (ft. MSL)	Hydraulic Conductivity (cm/sec)
Lower Zone Wells						
OW-6A	4/88	59.50	525.58	528.60	471.08 to 467.08	1.01×10^{-4}
OW-8A	3/88	73.08	522.01	525.10	453.93 to 449.93	9.96×10^{-4}
OW-10A	3/88	50.67	521.33	524.66	475.66 to 471.66	1.1×10^{-3}
OW-12A	3/88	52.91	527.36	527.22	479.45 to 475.45	5.35×10^{-3}
OW-14A	3/88	57.40	531.21	534.17	478.81 to 474.81	8.12×10^{-5}
OW-16	2/81	51.50	528.25	531.40	479.25 to 468.85	6.45×10^{-6}
OW-20A	4/88	95.50	523.31	526.19	432.81 to 428.81	1.40×10^{-3}
OW-22	2/81	63.20	519.80	522.84	473.60 to 456.60	4.82×10^{-4}
OW-24A	4/88	73.75	521.76	524.78	453.01 to 449.01	5.98×10^{-3}
OW-26	4/88	63.75	532.57	534.47	475.24 to 471.24	9.39×10^{-5}
OW-28	4/88	63.75	532.57	535.72	473.82 to 469.82	2.04×10^{-6}
OW-30	4/88	51.75	523.46	522.49	476.71 to 472.71	5.18×10^{-5}
OW-32	4/88	81.00	522.42	521.99	446.42 to 442.42	4.24×10^{-3}
OW-34	4/88	56.50	522.80	522.53	471.30 to 467.30	2.19×10^{-3}
OW-36	4/88	71.75	519.39	521.91	452.64 to 448.64	6.38×10^{-3}
OW-38	7/88	75.40	524.33	524.28	454.83 to 450.83	NM
OW-40	7/88	58.13	521.55	524.34	468.42 to 464.42	6.26×10^{-6}
OW-44	9/88	52.00	521.94	524.66	474.94 to 470.94	7.39×10^{-5}
OW-46	10/88	57.50	527.80	530.22	474.30 to 471.30	3.37×10^{-6}
OW-48	10/88	55.00	528.57	528.23	478.57 to 474.57	4.61×10^{-6}
OW-50	10/88	63.50	528.64	531.00	470.14 to 466.14	2.0×10^{-4}
OW-52	12/88	76.00	523.85	526.64	452.85 to 448.85	2.92×10^{-3}
OW-54	12/88	63.00	525.77	528.06	467.77 to 463.77	5.1×10^{-4}
OW-56	12/88	74.00	524.25	526.65	455.25 to 451.25	3.91×10^{-4}
OW-58	01/92	58.73	527.22	526.99	478.92 to 468.92	1.34×10^{-3}
OW-60	01/92	61.08	527.14	526.86	476.34 to 466.34	$>2 \times 10^{-3}$
Deep Zone Wells						
DOW-1	06/88	148.92	532.36	535.32	393.44 to 384.44	3.2×10^{-6}
DOW-2	07/88	117.50	521.59	524.55	433.09 to 405.09	NM
DOW-3	12/88	132.00	524.03	526.42	402.03 to 393.03	1.4×10^{-6}
DOW-4	12/90	151.05	520.46	521.51	387.46 to 370.66	8.2×10^{-7}
DOW-5	11/90	134.38	525.01	528.09	428.71 to 418.71	NM
DOW-6	11/90	145.17	524.00	526.67	396.50 to 386.50	1.4×10^{-3}

NM = Not Measured

Notes:
1) Upper Zone observation wells (OW-2, OW-4, and all odd numbered wells) are defined as an observation well in the overburden unconsolidated soils.
2) Lower Zone observation wells (even numbered wells, except OW-2 and OW-4) are screened in the top portion of limestone bedrock.
3) Deep Zone (DOW series) observation wells are screened down within the limestone formation.

TABLE 3-5
WATER LEVEL HISTORY (MSL)
OF SELECTED OBSERVATION WELLS AT
OCCIDENTAL CHEMICAL CORPORATION PLANT
MUSCLE SHOALS, ALABAMA

Well No.	Jan '87	Dec '87	May '88	July '88	Oct '88	Nov '88	Jan '89	May '89	Sept '89	Oct '90	March '91	June '91	Sept '91
OW-2	519.96	515.67	517.09	510.19	513.33	514.43	520.29	519.34	516.51	508.25	520.71	515.98	513.73
OW-3	517.38	514.04	515.36	510.80	511.84	513.93	517.66	517.40	515.78	512.18	516.81	515.33	514.28
OW-5A	521.77	517.90	520.32	512.65	514.76	515.43	524.62	521.48	518.65	513.33	524.23	519.91	516.40
OW-7	522.47	511.55	515.37	503.58	504.65	506.03	519.68	518.28	512.11	503.88	519.59	516.74	508.03
OW-9	523.99	522.11	517.35	513.67	516.55	517.07	520.82	519.15	516.97	515.02	520.19	517.24	515.88
OW-11	523.38	522.83	522.99	522.53	522.67	522.74	523.23	523.28	523.40	522.17	523.22	522.99	522.68
OW-13	525.28	515.87	519.75	511.76	513.15	514.17	525.18	523.01	522.51	511.75	525.15	519.39	515.63
OW-19	523.69	522.60	519.26	516.17	518.91	519.34	520.49	520.02	520.04	517.64	521.48	519.76	518.03
OW-21	520.27	518.94	519.06	516.65	518.00	518.39	519.95	519.77	518.95	515.73	519.78	519.52	515.92
OW-23	521.04	519.72	519.82	514.46	518.74	518.92	521.17	521.02	520.65	515.27	521.31	519.27	519.17
OW-25			515.06	506.54	510.49		527.11	522.51	520.02	508.65	526.36	516.82	511.76
OW-29			516.87	513.93	514.31	514.52	518.43	518.41	515.98	514.33	518.73	516.56	515.47
OW-31			517.27	515.65	514.12	514.47	518.80	518.45	516.80	512.67		518.37	515.58
OW-33			515.02	510.79	508.98	509.26	516.51	515.55	512.27	509.80	517.24	514.64	510.62

30-YEAR AVERAGE REGIONAL MONTHLY RAINFALL
MUSCLE SHOALS AIRPORT*
(Inches)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
5.17	4.30	6.22	4.71	4.33	3.52	4.59	3.06	3.82	2.81	3.75	5.30

Total: 51.58

*Within two miles of plant

TABLE 3-6
WATER LEVEL MEASUREMENTS (FT, MSL)
(Page 1 of 3)

Well No.	May 1989	September 1989	October 1990	March 1991	June 1991	September 1991	April 1992
OW-1	521.01	518.26	509.94	526.31	519.65	513.49	519.64
OW-2	519.34	516.51	508.25	520.71	515.98	513.73	518.24
OW-3	517.40	515.78	512.18	516.81	515.33	514.28	515.93
OW-4	517.71	515.91	510.71	520.16	516.21	512.64	515.73
OW-5A	521.48	518.65	513.33	524.23	519.91	516.40	521.05
OW-6A	518.99	516.49	510.50	520.47	517.65	513.66	518.07
OW-7	518.28	512.11	503.88	519.59	516.74	508.03	517.59
OW-8A	512.92	508.55	502.25	516.55	511.89	504.69	511.88
OW-9	519.15	516.97	515.02	520.19	517.24	515.88	518.04
OW-10A	519.23	517.27	514.81	520.20	517.68	516.00	518.20
OW-11	523.28	523.40	522.17	523.22	522.99	522.68	523.11
OW-12A	524.07	523.74	522.07	523.56	523.17	522.71	523.15
OW-13	523.01	522.51	511.75	525.15	519.39	515.63	519.69
OW-14A	522.55	521.24	510.52	524.51	519.07	514.58	519.22
OW-15A	519.82	517.49	506.48	524.39	517.40	511.25	517.91
OW-15B	522.89	523.31	511.02	NM	519.27	515.00	520.64
OW-16	519.02	516.26	505.22	524.00	516.78	510.10	517.11
OW-19	520.02	520.04	517.64	521.48	519.76	518.03	520.32
OW-20A	521.88	520.08	515.33	NM	520.78	517.55	520.51
OW-21	519.77	518.95	515.73	519.78	519.52	515.92	519.56
OW-22	521.38	519.46	513.79	522.04	520.44	516.64	520.39
OW-23	521.02	520.65	515.27	521.31	519.27	519.17	520.54
OW-24A	522.05	519.84	512.10	522.83	519.79	515.80	520.15
OW-25	522.51	520.02	508.65	526.36	516.82	511.76	517.05
OW-26	517.56	513.83	504.37	523.55	515.42	508.98	515.60
OW-27	524.15	521.53	517.67	526.80	522.28	520.08	523.15

NM = Not measured

TABLE 3-6
WATER LEVEL MEASUREMENTS (FT, MSL)
(Page 2 of 3)

Well No.	May 1989	September 1989	October 1990	March 1991	June 1991	September 1991	April 1992
OW-28	522.38	520.45	516.42	523.84	521.09	519.21	521.70
OW-29	518.41	515.98	514.33	518.73	516.56	515.47	517.24
OW-30	517.21	514.88	512.13	519.46	517.17	514.70	516.86
OW-31	518.45	516.80	512.67	NM	518.37	515.58	518.04
OW-32	520.45	517.12	511.29	NM	520.01	514.79	519.39
OW-33	515.55	512.27	509.80	517.24	514.64	510.62	515.24
OW-34	511.75	506.97	503.67	513.02	510.63	504.64	510.33
OW-36	510.23	505.12	501.90	512.19	509.84	503.50	509.13
OW-37	515.58	512.21	508.94	518.95	514.56	510.63	514.69
OW-38	513.57	509.11	504.98	517.62	512.79	507.01	512.68
OW-39	514.94	509.47	506.60	519.07	515.38	507.72	514.74
OW-40	514.28	509.26	505.92	518.61	514.26	507.36	514.18
OW-41	517.28	513.47	505.80	534.08	515.89	509.80	516.16
OW-43	NM (ARTESIAN)	523.13	P&A	P&A	P&A	P&A	P&A
OW-44	518.45	516.65	513.34	NM	517.41	514.91	518.16
OW-45	518.89	517.77	514.31	NM	517.65	516.24	518.68
OW-46	524.41	524.48	521.51	524.87	523.37	523.00	523.50
OW-47	524.01	524.24	521.71	523.88	522.79	522.64	522.89
OW-48	524.45	523.55	521.48	526.00	523.71	521.47	523.95
OW-49	526.13	524.89	522.62	527.45	524.88	523.91	525.05
OW-50	521.78	520.87	518.30	522.85	520.90	520.22	520.98
OW-51	525.41	525.59	523.41	525.28	524.76	524.29	524.37
OW-52	525.56	522.85	515.65	525.00	524.12	519.63	524.26
OW-53	524.06	521.30	513.77	526.50	522.54	518.69	523.17
OW-54	528.06	512.34	503.61	518.97	513.75	507.32	514.02
OW-55	515.38	511.19	503.61	519.81	513.85	507.72	514.16
OW-56	510.48	507.68	501.15	513.04	509.10	503.28	508.82

NM = Not Measured
P&A = Plugged and Abandoned

TABLE 3-6
WATER LEVEL MEASUREMENTS (FT, MSL)
(Page 3 of 3)

Well No.	May 1989	September 1989	October 1990	March 1991	June 1991	September 1991	April 1992
OW-57	510.42	507.60	501.37	513.18	509.38	503.16	508.94
DOW-1	514.70	510.40	507.53*	518.12	515.22	509.32	513.93
DOW-2	520.71	518.17	510.97*	521.44	520.24	514.56	519.81
DOW-3	525.72	523.14	515.83*	526.42	524.24	519.78	524.44
DOW-4	NE	NE	500.95*	521.30	510.93	503.98	510.53
DOW-5	NE	NE	498.68*	512.41	507.66	501.56	506.47
DOW-6	NE	NE	498.21*	513.24	509.48	502.54	508.79

NE = Not in existence
NM = Not measured
* = Water level measurements collected in late November 1989

TABLE 3-7
APPENDIX IX ANALYTICAL RESULTS (OW-14A and OW-27)
OCTOBER 1988

(All concentrations are in ug/l or ppb)

Constituent	OW-14A*	OW-27*	Water Standards (MCL)
Antimony	300	500	NA
Arsenic	<10	<10	50
Barium	400	100	2000
Beryllium	<10	<10	1
Cadmium	<5	190	5
Chromium	<10	<10	100
Cobalt	20	110	NA
Copper	30	40	1000+
Lead	<5	<5	NA
Mercury	30	30	2
Nickel	70	200	100
Selenium	<10	<10	50
Silver	40	30	100+
Thallium	200	300	NA
Tin	<1000	<1000	NA
Vanadium	<200	<200	NA
Zinc	110	450	5000+
Cyanide	<10	<10	200
Sulfide	<10	<10	NA

Notes:

1) *All acid extractable compounds, base neutral compounds, pesticide and PCB compounds, chlorinated herbicide compounds, dioxin and furan compounds, and volatile organic compounds were found to be below detectable limits.
2) +Secondary maximum contaminant levels (SMCLs)
3) NA = Not Available
4) Copies of the laboratory analyses can be found in Appendix B

WELL NO.	12/87 (OXY)-NF	12/87 (OXY)-NF	12/87 (WP)-F	4&5/88 (WP)-NF	6/88 (WP)-NF	7/88 (WP)-F	9/88 (WP)-F	10/88 (WP)-F	12/88 (WP)-F	12/88 (WP)-F	1/89 (WP)-F	5/8 (WP)-
OW-1 *	0.0	0.0	<0.2	<0.2	0.3	0.2	0.2	<0.2	NT	NT	NT	NT
OW-2 *	0.2	0.0	<0.2	<0.2	0.2	<0.2	<0.2	0.2	NT	NT	NT	NT
OW-3 *	0.5	0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	NT	NT	NT	NT
OW-4 *	0.2	0.0	<0.2	0.3	0.9	<0.2	0.8	<0.2	NT	NT	NT	NT
OW-5A	NE	NE	NE	0.9	2.5	1.1	1.0	4.0	9.0	NT	NT	NT
OW-6A	NE	NE	NE	21.0	19.0	1.2	2.2	10.0	17.0	NT	NT	NT
OW-7	6.3	2.6	<0.2	0.7	0.5	<0.2	<0.2	<0.2	NT	NT	NT	NT
OW-8A	NE	NE	NE	<0.2	1.8	<0.2	0.2	<0.2	NT	NT	NT	NT
OW-9	30.0	24.0	<0.2	5.1	2.2	<0.2	<0.2	0.7	0.3	NT	NT	NT
OW-10A	NE	NE	NE	81.0	8.8	5.8	0.7	0.9	0.7	NT	NT	NT
OW-11	52.0	11.5	6.4	25.0	10.1	<0.2	0.7	<0.2	<0.2	NT	NT	NT
OW-12A	NE	NE	NE	1.0	1.2	<0.2	<0.2	<0.2	<0.2	NT	NT	NT
OW-13	220.0	23.0	2.2	6.1	6.5	0.8	0.3	4.0	4.6	NT	NT	NT
OW-14A	NE	NE	NE	6.5	7.3	19.0	5.3	30.0	17.0	NT	NT	NT
OW-15A	1.4	1.2	<0.2	0.8	0.5	0.2	<0.2	0.3	NT	NT	NT	NT
OW-15B	1.1	1.4	0.3	<0.2	1.2	<0.2	<0.2	<0.2	NT	NT	NT	NT
OW-16	0.0	<0.1	<0.2	3.1	0.2	<0.2	<0.2	<0.2	NT	NT	NT	NT
OW-17	3.0	2.5	<0.2	NE	NE	NE	NE	NE	NE	NE	NT	NT
OW-18	2.1	3.6	<0.2	NE	NE	NE	NE	NE	NE	NE	NT	NT
OW-19	1.1	4.1	<0.2	2.0	0.4	<0.2	1.1	<0.2	NT	NT	NT	NT
OW-20A	NE	NE	NE	1.8	1.8	<0.2	<0.2	0.3	NT	NT	NT	NT
OW-21	0.8	0.2	<0.2	34.0	0.7	<0.2	<0.2	0.9	NT	NT	NT	NT
OW-22	2.7	1.5	<0.2	1.2	3.0	<0.2	0.3	0.2	NT	NT	NT	NT
OW-23	0.5	1.2	<0.2	0.5	1.0	0.2	<0.2	<0.2	NT	NT	NT	NT
OW-24A	NE	NE	NE	3.2	0.6	<0.2	0.6	<0.2	NT	NT	NT	NT
OW-25	NE	NE	NE	0.5	1.1	<0.2	1.3	0.7	NT	0.2	NT	NT
OW-26	NE	NE	NE	10.0	2.1	<0.2	<0.2	0.3	NT	NT	NT	NT
OW-27	NE	NE	NE	78.0	69.0	34.0	13.0	30.0	27.0	NT	NT	NT
OW-28	NE	NE	NE	17.0	6.0	0.2	<0.2	0.3	0.3	NT	NT	NT
OW-29	NE	NE	NE	0.2	0.7	<0.2	<0.2	3.0	<0.2	NT	NT	NT
OW-30	NE	NE	NE	8.9	5.0	<0.2	<0.2	0.7	<0.2	NT	NT	NT
OW-31	NE	NE	NE	1.1	4.1	<0.2	0.8	0.2	<0.2	NT	NT	NT
OW-32	NE	NE	NE	3.2	0.4	<0.2	0.3	0.9	<0.2	NT	NT	NT
OW-33	NE	NE	NE	2.2	1.1	<0.2	0.3	<0.2	NT	NT	NT	NT
OW-34	NE	NE	NE	1.2	<0.2	<0.2	<0.2	<0.2	NT	NT	NT	NT
OW-36	NE	NE	NE	<0.2	0.7	0.2	<0.2	<0.2	NT	NT	NT	NT
OW-37	NE	NE	NE	NE	<0.2	<0.2	<0.2	<0.2	NT	NT	NT	NT
OW-38	NE	NE	NE	NE	<0.2	<0.2	<0.2	0.2	NT	NT	NT	NT
OW-39	NE	NE	NE	NE	1.0	<0.2	<0.2	0.3	NT	NT	NT	NT
OW-40	NE	NE	NE	NE	<0.2	<0.2	0.2	<0.2	0.4	NT	NT	NT
OW-41	NE	NE	NE	NE	7.0	0.6	0.2	3.0	0.3	NT	NT	NT
OW-43	NE	NE	NE	NE	1.0	<0.2	0.3	0.4	NT	NT	NT	0.2
OW-44	NE	NE	NE	NE	NE	NE	1.4	<0.2	NT	NT	NT	NT
OW-45	NE	NE	NE	NE	NE	NE	0.2	<0.2	NT	NT	NT	NT
OW-46	NE	NE	NE	NE	NE	NE	NE	340.0	140.0	140.0	140.0	90.
OW-47	NE	NE	NE	NE	NE	NE	NE	8.0	200.0	NT	NT	19
OW-48	NE	NE	NE	NE	NE	NE	NE	0.4	0.6	NT	NT	<0.
OW-49	NE	NE	NE	NE	NE	NE	NE	130.0	110.0	110.0	110.0	110.
OW-50	NE	NE	NE	NE	NE	NE	NE	6.0	16.0	NT	NT	21
OW-51	NE	NE	NE	NE	NE	NE	NE	<0.2	0.9	NT	NT	0.6
OW-52	NE	NE	NE	NE	NE	NE	NE	NE	NT	NE	<0.2	0.2
OW-53	NE	NE	NE	NE	NE	NE	NE	NE	NT	NE	0.2	<0.
OW-54	NE	NE	NE	NE	NE	NE	NE	NE	NT	0.3	NT	0.4
OW-55	NE	NE	NE	NE	NE	NE	NE	NE	NT	<0.2	NT	0.2
OW-56	NE	NE	NE	NE	NE	NE	NE	NE	NT	0.2	NT	<0.
OW-57	NE	NE	NE	NE	NE	NE	NE	NE	NT	<0.2	NT	0.4
OW-58	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
OW-59	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
OW-60	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
OW-61	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
DOW-1	NE	NE	NE	NE	<0.2	<0.2	<0.2	0.3	NT	NT	NT	NT
DOW-2	NE	NE	NE	NE	NE	0.3	7.4	20.0	0.8	NT	NT	20
DOW-3	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	<0.2	0.8
DOW-4	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
DOW-5	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
DOW-6	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

LEGEND

NE -- WELL NOT IN EXISTENCE
NT -- WELL NOT TESTED
93.7/65.2 -- WELL CONCENTRATION/REPLICATE CONCENTRATION
(WP) -- WEST PAINE LABORATORY
(OXY) -- OXYCHEM LABORATORY
(SPL) -- SOUTHERN PETROLEUM LABORATORY
F -- SAMPLE WAS FILTERED PRIOR TO ANALYSIS
NF -- SAMPLE WAS NOT FILTE[RED PRIOR] TO ANALYSIS

DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATIO[N]
NIAGARA FALLS, NEW YORK
Client

DRAWN BY: A.B. LAPRARIE 6-3-92
CHECKED BY
APPROVED BY
DRAWING NO. 87-0188-B139

9/89 (WP)-F	10/90 (WP)-F	11-12/90 (WP)-F	3/91 (WP)-F	6/91 (SPL)-F	9/91 (SPL)-F	9/91 (SPL)-NF	1/92 (SPL)-F	1/92 (SPL)-NF	4/92 (SPL)-NF	4/92 (SPL)-F
0.3	<0.2	NT	NT	<0.2	NT	NT	NT	NT	0.3	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	0.9	NT	NT	NT	NT	<0.2	<0.2
0.3	<0.2	NT	NT	<0.2	NT	NT	NT	NT	0.6	0.7
13.0	10.0	NT	NT	45.1	27.7/19.6	28.1	27.2/31.2	28.7/33.0	15.5/21.2/22.1/22.4	16.8
30.0	7.0	NT	NT	221.6	64.2/24.2	195.6	180.0/202.3	155.0/129.1	201.4/244/256/246	135.0
0.3	0.6	0.2	NT	2	NT	NT	NT	NT	<0.2/<0.2/<0.2/<0.2	<0.2
0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2/<0.2/<0.2/<0.2	<0.2
0.7	0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2/0.4/0.3/0.3	<0.2
0.3	0.6	0.3	NT	0.2	NT	NT	4.6/4.1	2.9/2.6	<0.2/<0.2/<0.2/<0.2	<0.2
0.3	0.6	0.3	NT	<0.2	NT	NT	0.8/<0.2	4.6/4.4	<0.2/0.2/0.4/0.7	<0.2
0.2	0.9	<0.2	NT	<0.2	NT	NT	NT	NT	1.3/2.1/2.5/3.0	0.5
<0.2	2.0	NT	NT	0.9/0.5	NT	NT	NT	NT	1.1	<0.2
4.0	5.0	NT	NT	7.1/7.7	NT	NT	NT	NT	8.2	1.1
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	0.4	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	0.3	<0.2
NE	NE	NE	NE	NE	NT	NT	NT	NT	NE	NE
NE	NE	NE	NE	NE	NT	NT	NT	NT	NE	NE
<0.2	0.6	NT	NT	<0.2/<0.2	NT	NT	NT	NT	<0.2/0.4/<0.2/<0.2	<0.2
0.2	<0.2	NT	NT	<0.2/<0.2	NT	NT	NT	NT	<0.2/<0.2/<0.2/<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2/<0.2/<0.2/<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	0.5/0.5/0.3/<0.2	<0.2
0.3	<0.2	NT	NT	0.8/<0.2	NT	NT	NT	NT	<0.2/<0.2/<0.2/<0.2	<0.2
0.2	<0.2	NT	NT	<0.2/<0.2	NT	NT	NT	NT	<0.2/<0.2/<0.2/<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
30.0	30.0	NT	NT	46.0/38	NT	NT	NT	NT	34.2/45.2/38.6/43.6	19.4
3.0	8.0	NT	NT	11.4/10.1	NT	NT	NT	NT	14.5/16.1/13.5/15.2	7.4
0.8	<0.2	NT	NT	<0.2	NT	NT	NT	NT	0.9	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	0.4	0.8
0.4	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2/0.3/<0.2/0.4	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	0.4/0.2/<0.2/0.5	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
0.4	<0.2	NT	NT	0.2	NT	NT	NT	NT	4.4	1.1
0.2	NE	NE	NE	NE	NT	NT	NT	NT	NE	NE
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	0.2	NT	NT	NT	NT	8.0	14.0
50.0	10.0	NT	NT	93.7/65.2	NT	NT	NT	NT	101.2/98.4/109.8/103.8	99.2
280.0	110	70	NT	368.8/335.5	NT	NT	NT	NT	411.0/438/443/438	408.0
0.4	<0.2	NT	NT	0.5/0.3	NT	NT	NT	NT	1.3	0.8
66.0	12	7.0	NT	91.7/88.0	NT	NT	NT	NT	60.4	51.6
23.0	25	7.0	NT	58	NT	NT	NT	NT	84.4/<0.2/84.9/83.1	66.1
0.5	<0.2	NT	NT	0.5	NT	NT	NT	NT	<0.2/<0.2/<0.2/<0.2	2.7
0.6	0.9	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
0.3	<0.2	NT	NT	0.4	NT	NT	NT	NT	<0.2	<0.2
0.3	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
<0.2	<0.2	NT	NT	<0.2	NT	NT	NT	NT	<0.2	<0.2
NE	NE	NE	NE	NE	NE	NE	<0.2/<0.2	<0.2/0.3	0.2/<0.2/<0.2/0.2	<0.2
NE	NE	NE	NE	NE	NE	NE	<0.2/<0.2	<0.2/<0.2	<0.2/<0.2/<0.2/<0.2	<0.2
NE	NE	NE	NE	NE	NE	NE	<0.2/0.2	<0.2/<0.2	1.5/1.4/1.6/1.3	0.2
NE	NE	NE	NE	NE	NE	NE	1.2/4.1	5.1/3.2	15.7/18.2/19/18.4	4.7
0.6	NT	<0.2	0.8	<0.2/<0.2	<0.2/<0.2	<0.2	NT	NT	<0.2	<0.2
3.0	NT	20	20.0	0.3/<0.2	<0.2/<0.2	64.8	NT	NT	10.1	4.4
0.4	NT	<0.2	0.3	<0.2/<0.2	<0.2/<0.2	<0.2	NT	NT	<0.2	<0.2
NE	NE	<0.2	4.0	<0.2/<0.2	<0.2/<0.2	<0.2	NT	NT	<0.2	1.2
NE	NE	0.2	<0.2	<0.2/<0.2	<0.2/<0.2	<0.2	NT	NT	0.3	<0.2
NE	NE	<0.2	<0.2	<0.2/<0.2	<0.2/<0.2	<0.2	NT	NT	<0.2	<0.2

NOTES: 1) ALL RESULTS REPORTED IN ug/l OR PARTS PER MILLION (ppb).

PRIOR

2) * OW-1 THROUGH OW-4, INSTALLED IN 1980, FORMED THE ORIGINAL ARRAY OF MONITOR WELLS. THE WELLS WERE REGULARLY SAMPLED ANALYZED BY PLANT PERSONNEL AND NEVER EXCEED 1.0 ppb MERCURY.

G&E ENGINEERING, INC.

ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY

MUSCLE SHOALS, ALABAMA

Project Title

MERCURY GROUNDWATER ANALYSES

3-8

Table

DRAWN BY | A.B. LAPRARIE 6-9-92 | CHECKED BY | APPROVED BY | 6/25/92 | 6/25/92 | DRAWING NO. 87-0188-B137

WELL NO.	10-12/88 (WP)-F	1/89 (WP)-F	5/89 (WP)-F	9/89 (WP)-F	10/90 (WP)-F	11/90 (WP)-F	3/91 (WP)-F	6/91 (SPL)-F	9/91 (SPL)-F	9/91 (SPL)-NF	1/ (SP
OW-1	NT	NT	NT	NT	<5	NT	NT	8	NT	NT	
OW-2	NT	NT	NT	NT	<5	NT	NT	0.9	NT	NT	
OW-3	NT	NT	NT	NT	<5	NT	NT	1	NT	NT	
OW-4	NT	NT	NT	NT	<5	NT	NT	1	NT	NT	
OW-5A	<5	NT	NT	<5	14	NT	NT	1	6.4/3.9	6.7	3.8
OW-6A	80	NT	NT	60	12	NT	NT	14	31.1/14.4	32.0	146.0
OW-7	<5	NT	NT	<5	<5	NT	NT	2	NT	NT	
OW-8A	<5	NT	NT	<5	<5	NT	NT	0.7	NT	NT	
OW-9	<5	NT	NT	<5	<5	NT	NT	2	NT	NT	
OW-10A	30	NT	7	30	<5	NT	NT	33	NT	NT	
OW-11	<5	NT	NT	<5	<5	NT	NT	2	NT	NT	0.5
OW-12A	<5	NT	NT	<5	<5	NT	NT	2	NT	NT	4.4
OW-13	<5	NT	NT	<5	<5	NT	NT	3/2	NT	NT	
OW-14A	<5	NT	NT	<5	<5	NT	NT	6/3	NT	NT	
OW-15A	NT	NT	NT	NT	<5	NT	NT	1	NT	NT	
OW-15B	NT	NT	NT	NT	<5	NT	NT	4	NT	NT	
OW-16	NT	NT	NT	NT	<5	NT	NT	5	NT	NT	
OW-19	<5	NT	NT	<5	<5	NT	NT	1/0.9	NT	NT	
OW-20A	NT	NT	NT	<5	11	NT	NT	21/13	NT	NT	
OW-21	<5	NT	NT	<5	<5	NT	NT	22.5	NT	NT	
OW-22	NT	NT	NT	<5	<5	NT	NT	2	NT	NT	
OW-23	<5	NT	NT	<5	<5	NT	NT	3/2	NT	NT	
OW-24A	<5	NT	NT	<5	12	NT	NT	<0.1/<0.1	NT	NT	
OW-25	NT	NT	NT	NT	<5	NT	NT	1	NT	NT	
OW-26	NT	NT	NT	NT	<5	NT	NT	1	NT	NT	
OW-27	70	NT	NT	10	11	NT	NT	<0.1/1	NT	NT	
OW-28	100	NT	NT	33	17	NT	NT	17/59	NT	NT	
OW-29	NT	NT	NT	NT	<5	NT	NT	2	NT	NT	
OW-30	NT	NT	NT	NT	<5	NT	NT	1	NT	NT	
OW-31	NT	NT	NT	NT	<5	NT	NT	1	NT	NT	
OW-32	NT	NT	NT	NT	<5	NT	NT	0.6	NT	NT	
OW-33	NT	NT	NT	NT	<5	NT	NT	4	NT	NT	
OW-34	NT	NT	NT	NT	<5	NT	NT	2	NT	NT	
OW-36	NT	NT	NT	NT	<5	NT	NT	5	NT	NT	
OW-37	<5	NT	NT	<5	<5	NT	NT	1	NT	NT	
OW-38	<5	NT	NT	<5	<5	NT	NT	5	NT	NT	
OW-39	<5	NT	NT	<5	<5	NT	NT	0.9	NT	NT	
OW-40	<5	NT	<5	<5	<5	NT	NT	0.2	NT	NT	
OW-41	<5	NT	NT	<5	<5	NT	NT	0.7	NT	NT	
OW-43	NT	NT	<5	NT	NE	NE	NE	NE	NT	NT	
OW-44	NT	NT	NT	NT	<5	NT	NT	3	NT	NT	
OW-45	NT	NT	NT	NT	<5	NT	NT	4	NT	NT	
OW-46	330	NT	80	250	11	NT	NT	<0.1/2	NT	NT	
OW-47	250	NT	40	<5	12	NT	NT	1/0.3	NT	NT	
OW-48	170	NT	30	<5	11	NT	NT	6.6/6.0	NT	NT	
OW-49	160	NT	30	<5	11	NT	NT	2.8	NT	NT	
OW-50	10	NT	5	<5	14	NT	NT	5	NT	NT	
OW-51	<5	NT	<5	<5	<5	NT	NT	10.6	NT	NT	
OW-52	<5	<5	NT	<5	<5	NT	NT	1	NT	NT	
OW-53	<5	<5	NT	<5	<5	NT	NT	1	NT	NT	
OW-54	NT	NT	NT	NT	<5	NT	NT	<0.1	NT	NT	
OW-55	NT	NT	NT	NT	<5	NT	NT	1.4	NT	NT	
OW-56	NT	NT	NT	NT	<5	NT	NT	2	NT	NT	
OW-57	NT	NT	<5	NT	<5	NT	NT	0.5	NT	NT	
OW-58	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	1.0
OW-59	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.6
OW-60	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.9
OW-61	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	1.5
DOW-1	<5	NT	NT	<5	NT	<5	<5	<0.1/0.8	0.6/<0.1	0.6	
DOW-2	30	NT	30	30	NT	21	70	<0.1/<0.1	2.0/<0.1	32.5	
DOW-3	NE	<5	<5	<5	NT	<5	<5	<0.1/<0.1	<0.1/<0.1	7.1	
DOW-4	NE	NE	NE	NE	NE	<5	<5	0.4/1	<0.1/0.2	4.0	
DOW-5	NE	NE	NE	NE	NE	<5	<5	1/4	0.3/0.6	0.1	
DOW-6	NE	NE	NE	NE	NE	<5	<5	1/2	0.1/<0.1	<0.1	

DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATIO

NIAGARA FALLS, NEW YORK

Client

1/92 SPL)–NF	4/92 (SPL)–NF	4/92 (SPL)–F
NT	0.3	<0.1
NT	<0.1	<0.1
NT	0.8	0.5
NT	<0.1	0.3
3.7/3.6	5.6/35.2/9.6/33.2	4.2
'8.0/167.0	120/114/104/78.6	102.8
NT	0.2/0.1/0.2/<0.1	0.3
NT	0.6/0.5/0.5/0.3	0.6
NT	3.2/2.6/31.8/9.8	2.3
NT	158/105/65.4/15.3	50.4
0.7/0.6	<0.1/<0.1/<0.1/<0.1	0.2
5.8/7.8	0.2/0.3/0.6/0.4	0.2
NT	0.3	<0.1
NT	1.1	0.9
NT	<0.1	<0.1
NT	0.4	<0.1
NT	0.2	<0.1
NT	0.2/<0.1/<0.1/<0.1	<0.1
NT	24/19/43.4/45	7.0
NT	10.5/15.1/8.9/5.4	3.4
NT	0.4/<0.1/0.3/<0.1	0.4
NT	0.5/0.2/0.2/0.3	0.6
NT	4.1/0.7/0.1/7.0	0.6
NT	<0.1	<0.1
NT	0.3	<0.1
NT	2.1/2.8/107/6	0.8
NT	223/65.6/83.8/104	43.2
NT	0.8	0.3
NT	<0.1	0.1
NT	<0.1	0.2
NT	<0.1	0.1
NT	0.1	<0.1
NT	0.2	0.2
NT	1.3	1.3
NT	<0.1/0.8/<0.1/<0.1	<0.1
NT	0.1/<0.1/<0.1/<0.1	<0.1
NT	0.7	0.3
NT	2.7	1.5
NT	5.1	4.8
NT	NE	NE
NT	0.2	0.3
NT	<0.1	<0.1
NT	333/296/310/248	323
NT	3.0/17.8/<0.1/14.8	2.8
NT	252	165.6
NT	5.5	4.7
NT	128/28.6/37.8/34.8	91.2
NT	0.6/<0.1/<0.1/<0.1	0.5
NT	0.1	<0.1
NT	0.1	0.3
NT	34.5	19.6
NT	0.3	0.6
NT	0.2	0.3
NT	0.2	0.5
1.5/1.2	0.5/<0.1/<0.1/<0.1	<0.1
0.8/0.5	0.1/<0.1/<0.1/<0.1	<0.1
1.8/2.0	<0.1/0.7/0.6/0.7	0.3
1.8/2.5	0.9/0.8/0.7/0.8	0.8
NT	5.9	2.0
NT	83.2	78.8
NT	2.1	0.6
NT	1.8	0.8
NT	0.5	0.6
NT	0.2	0.6

LEGEND

NE -- WELL NOT IN EXISTENCE

NT -- WELL NOT TESTED

17/59 -- WELL CONCENTRATION/REPLICATE CONCENTRATION

(WP) -- WEST PAINE LABORATORY

(SPL) -- SOUTHERN PETROLEUM LABORATORY

F -- SAMPLE WAS FILTERED PRIOR TO ANALYSIS

NF -- SAMPLE WAS NOT FILTERED PRIOR TO ANALYSIS

NOTE: ALL RESULTS REPORTED IN PARTS PER BILLION (ppb)

G&E
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ENVIRONMENTAL CONSULTANTS

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CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

CADMIUM GROUNDWATER ANALYSES

3-9
Table

DRAWING NO. 87-0188-B184

DRAWN BY	A.B. LAPRARIE 5-28-92
CHECKED BY	
APPROVED BY	

WELL NO.	12/87 (OXY)-NF	12/87 (OXY)-NF	12/87 (WP)-F	4&5/87 (WP)-NF	6/88 (WP)-F	7/88 (WP)-F	9/88 (WP)-F	10/88 (WP)-F	12/88 (WP)-F	12/88 (WP)-F	1/89 (WP)-F	2/89 (WP)-F	5/89 (WP)-F	9/89 (WP)-F	10/90 (WP)-F	11- (
OW-1	3	27	6	40	8	6	7	8	NT	NT	NT	NT	NT	8	8.8	
OW-2	3	23	4	8	8	5	5	8	NT	NT	NT	NT	NT	6	5.8	
OW-3	9	36	2	10	5	5	5	5	NT	NT	NT	NT	NT	6	6	
OW-4	458	54	30	54	34	40	43	45	NT	NT	NT	NT	NT	34	37.5	
OW-5A	NE	NE	NE	3500	4450	5000	10400	6450	5650	NT	NT	NT	NT	4380	4925	
OW-6A	NE	NE	NE	11100	11400	13500	22000	18500	17000	NT	NT	NT	NT	12000	27500	2
OW-7	552	591	600	620	550	720	680	590	NT	NT	NT	NT	NT	670	525	
OW-8A	NE	NE	NE	1100	1700	2040	2200	1950	NT	NT	NT	NT	NT	1590	1900	
OW-9	6238	6710	5800	6000	6250	6400	8000	6800	5500	NT	NT	NT	NT	4900	6500	
OW-10A	NE	NE	NE	8250	6650	6650	4700	4600	4580	NT	NT	NT	NT	5930	3000	
OW-11	71	81	50	75	65	75	70	27	51	NT	NT	NT	NT	28	62.5	
OW-12A	NE	NE	NE	470	370	405	412	435	395	NT	NT	NT	NT	325	36.2	
OW-13	357	259	250	250	335	320	320	315	280	NT	NT	NT	NT	340	41.2	
OW-14A	NE	NE	NE	1350	1590	1740	2150	1900	2180	NT	NT	NT	NT	1650	1620	
OW-15A	71	39	<1	4	3	1	<1	<1	NT	NT	NT	NT	NT	1	1.2	
OW-15B	36	27	6	<1	7	2	2	2	NT	NT	NT	NT	NT	3	2.2	
OW-16	90	116	95	100	98	94	94	85	NT	NT	NT	NT	NT	77	100	
OW-17	178	72	2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
OW-18	999	106	1000	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
OW-19	1979	1847	2000	585	525	350	320	540	NT	NT	NT	NT	NT	250	202	
OW-20A	NE	NE	NE	24000	10400	11000	12000	11800	NT	NT	NT	NT	NT	1330	10200	
OW-21	981	939	950	1000	885	860	940	975	NT	NT	NT	NT	NT	850	1380	
OW-22	250	161	150	100	130	119	106	104	NT	NT	NT	NT	NT	125	1000	
OW-23	999	1029	1050	1300	460	950	975	1050	NT	NT	NT	NT	NT	1040	1080	
OW-24A	NE	NE	NE	3300	2800	3370	4170	4150	NT	NT	NT	NT	NT	5600	6380	
OW-25	NE	NE	NE	20	7	5	5	5	NT	NT	NT	NT	NT	4	25.2	
OW-26	NE	NE	NE	110	109	122	124	142	NT	NT	NT	NT	NT	150	148	
OW-27	NE	NE	NE	8500	8900	9750	14000	12200	11800	NT	NT	NT	NT	18400	10400	
OW-28	NE	NE	NE	4300	4950	5250	12000	6500	6150	NT	NT	NT	NT	5730	6000	
OW-29	NE	NE	NE	1750	1750	1650	1500	1300	1640	NT	NT	NT	NT	1560	1700	
OW-30	NE	NE	NE	265	315	338	300	300	240	NT	NT	NT	NT	130	185	
OW-31	NE	NE	NE	53	36	18	14	15	13	NT	NT	NT	NT	9.0	10	
OW-32	NE	NE	NE	26	8	8	6	6	4	NT	NT	NT	NT	5.0	2.9	
OW-33	NE	NE	NE	17	9	14	17	15	NT	NT	NT	NT	NT	10.5	10.8	
OW-34	NE	NE	NE	27	22	24	21	40	NT	NT	NT	NT	NT	40	23.5	
OW-36	NE	NE	NE	22	14	21	22	37	NT	NT	NT	NT	NT	25.5	17.5	
OW-37	NE	NE	NE	NE	77	72	65	72	NT	NT	NT	NT	NT	22	20.5	
OW-38	NE	NE	NE	NE	77	71	72	65	NT	NT	NT	NT	NT	55	44	
OW-39	NE	NE	NE	NE	120	250	260	252	NT	NT	NT	NT	NT	200	250	
OW-40	NE	NE	NE	NE	2520	2680	3100	3350	3075	NT	NT	NT	NT	2260	1940	
OW-41	NE	NE	NE	NE	2650	2800	1400	1200	2000	NT	NT	NT	NT	2340	2400	
OW-43	NE	NE	NE	NE	2770	3200	215	140	NT	NT	NT	NT	460	460	NE	
OW-44	NE	NE	NE	NE	NE	NE	70	65	NT	NT	NT	NT	NT	69.5	87.5	
OW-45	NE	NE	NE	NE	NE	NE	10	2	NT	NT	NT	NT	NT	5.0	57.5	
OW-46	NE	NE	NE	NE	NE	NE	NE	70000	69000	72500	72500	NT	65000	66000	63800	
OW-47	NE	NE	NE	NE	NE	NE	NE	93500	91000	NT	NT	NT	95000	88500	102000	
OW-48	NE	NE	NE	NE	NE	NE	NE	18000	21800	NT	NT	NT	1800	2780	170000	1
OW-49	NE	NE	NE	NE	NE	NE	NE	67000	63000	85000	85000	NT	62000	53500	53800	
OW-50	NE	NE	NE	NE	NE	NE	NE	3850	4025	NT	NT	NT	4100	4630	5500	
OW-51	NE	NE	NE	NE	NE	NE	NE	132	165	NT	NT	NT	160	110	125	
OW-52	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	13.5	31	48	49	80	
OW-53	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	9.0	6.5	7.2	8	7.5	
OW-54	NE	NE	NE	NE	NE	NE	NE	NE	NT	2350	NT	NT	3500	3700	5620	
OW-55	NE	NE	NE	NE	NE	NE	NE	NE	NT	44	NT	NT	32	49	45	
OW-56	NE	NE	NE	NE	NE	NE	NE	NE	NT	99	NT	NT	380	185	208	
OW-57	NE	NE	NE	NE	NE	NE	NE	NE	NT	13	NT	NT	8.2	5.2	3	
OW-58	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
OW-59	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
OW-60	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
OW-61	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
DOW-1	NE	NE	NE	NE	4000	4250	4300	4520	NT	NT	NT	NT	NT	5300	NT	
DOW-2	NE	NE	NE	NE	NE	15700	30000	17500	15533	NT	NT	NT	18000	25500	NT	1
DOW-3	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	1200	1600/1580/1950	2000	1360	NT	
DOW-4	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
DOW-5	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
DOW-6	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	

DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATIO

NIAGARA FALLS, NEW YORK

Client

3/91 (WP)-F	6/91 (SPL)-F	9/91 (SPL)-F	9/91 (SPL)-NF	1/92 (SPL)-F	1/92 (SPL)-NF	4/92 (SPL)-NF
NT	11.9	NT	NT	NT	NT	8.9
NT	56.6	NT	NT	NT	NT	10.6
NT	582	NT	NT	NT	NT	5.3
NT	57.6	NT	NT	NT	NT	42.5
NT	4500	4800/4880	4800	4660/4540	4660/4620	4650/4400/4550/4500
NT	30,700	25200/25300	25300	26400/25700	26500/25800	26500/27000/27000/27500
NT	741	NT	NT	NT	NT	575/575/575/575
NT	1600	NT	NT	NT	NT	450/500/450/475
NT	5000	NT	NT	NT	NT	5150/5250/5250/5050
NT	6980	NT	NT	NT	NT	6600/6600/6650/6600
NT	126	NT	NT	35.1/35.7	33.6/35.7	31.9/35.5/39.9/38.4
NT	383	NT	NT	328/330	333/335	23.6/23.6/26.6/23.6
NT	287/291	NT	NT	NT	NT	300
NT	1410/1420	NT	NT	NT	NT	1250
NT	7.7	NT	NT	NT	NT	1.8
NT	4.2	NT	NT	NT	NT	3.5
NT	80.9	NT	NT	NT	NT	85.7
NE	NE	NE	NE	NE	NE	NE
NE	NE	NE	NE	NE	NE	NE
NT	308/325	NT	NT	NT	NT	500/483/517/517
NT	13,600/14,100	NT	NT	NT	NT	2100/2150/2050/2050
NT	2870	NT	NT	NT	NT	2500/2550/2550/2750
NT	232	NT	NT	NT	NT	115/133/124/115
NT	939/1020	NT	NT	NT	NT	1020/1050/1000/1000
NT	4000/3900	NT	NT	NT	NT	3550/3750/3500/3600
NT	26.4	NT	NT	NT	NT	5.3
NT	80.4	NT	NT	NT	NT	130
NT	9050/9050	NT	NT	NT	NT	8600/8750/9000/8800
NT	5560/5710	NT	NT	NT	NT	6250/6050/6150/6150
NT	1520	NT	NT	NT	NT	1550
NT	85.4	NT	NT	NT	NT	94.5
NT	16.3	NT	NT	NT	NT	8.9
NT	5.6	NT	NT	NT	NT	5.3
NT	11.5	NT	NT	NT	NT	17.7
NT	26.4	NT	NT	NT	NT	19.5
NT	29.3	NT	NT	NT	NT	29.5
NT	41	NT	NT	NT	NT	32.5/35.5/38.4/38.4
NT	278	NT	NT	NT	NT	7.1/8.9/8.9/7.1
NT	252	NT	NT	NT	NT	275
NT	1490	NT	NT	NT	NT	1220
NT	1880	NT	NT	NT	NT	4100
NE	NE	NE	NE	NE	NE	NE
NT	119	NT	NT	NT	NT	76.8
NT	41.7	NT	NT	NT	NT	59.1
NT	NT	NT	NT	NT	NT	56500/55000/55000/55500
NT	NT	NT	NT	NT	NT	94000/92000/94500/92500
NT	NT	NT	NT	NT	NT	20500
NT	NT	NT	NT	NT	NT	44500
NT	5410	NT	NT	NT	NT	5300/5300/5450/5300
NT	118	NT	NT	NT	NT	70.9/67.4/76.2/72.7
NT	109	NT	NT	NT	NT	120
NT	8.9	NT	NT	NT	NT	7.1
NT	3680	NT	NT	NT	NT	3800
NT	1310	NT	NT	NT	NT	266
NT	216	NT	NT	NT	NT	219
NT	5	NT	NT	NT	NT	3.5
NE	NE	NE	NE	60.0/61.5	65.8/63.0	283/300/317/333
NE	NE	NE	NE	109/316	110/318	82.7/94.5/91.6/91.6
NE	NE	NE	NE	66.0/65.5	66.0/65.5	500/583/566/566
NE	NE	NE	NE	558/500	581/511	1120/1120/1000/1080
4520	4536/4570	4550/4600	4600	NT	NT	4650
16400	787/593	14400/11200	14500	NT	NT	13500
2050	2510/2470	3100/2800	3100	NT	NT	2250
45	40/26.8	14.8/31.0	14.8	NT	NT	8.9
75	91.8/91.3	79.8/82.7	84.2	NT	NT	82.7
132	213/218	233/213	233	NT	NT	216

LEGEND

NE — WELL NOT IN EXISTENCE
NT — WELL NOT TESTED
61,100/48,600 — WELL CONCENTRATION/REPLICATE CONCENTRATION
(WP) — WEST PAINE LABORATORY
(OXY) — OXYCHEM LABORATORY
(SPL) — SOUTHERN PETROLEUM LABORATORY
F — SAMPLE WAS FILTERED PRIOR TO ANALYSIS
NF — SAMPLE WAS NOT FILTERED PRIOR TO ANALYSIS

NOTE: ALL RESULTS REPORTED IN mg/l OR PARTS PER MILLION (ppm).

G&E
ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

CHLORIDE GROUNDWATER ANALYSES

3-10
Table

TABLE 3-11
SURFACE WATER AND SURFACE SOIL ANALYSES - MAY 1989
MISCELLANEOUS SAMPLING

Sample Location (Sample ID)	Water Hg (µg/l)	Water Cd (µg/l)	Water Cl (mg/l)	Soil Total Analysis Hg (mg/kg)	Soil Total Analysis Cd (mg/kg)	Soil Total Analysis Cl (mg/kg)	Soil EP Tox Extractable Analysis Hg (µg/l)	Soil EP Tox Extractable Analysis Cd (µg/l)
South Area								
SS-1 (0188-1)	N/A	N/A	N/A	12	<0.5	<10	<0.2	<10
SS-2 (0188-2)	N/A	N/A	N/A	<0.0002+	0.8	<10	0.4	<10
SS-3 (0188-3)	N/A	N/A	N/A	1.1	<0.5	350	<0.2	<10
SW-3 (0188-3W)	<0.2	<5	1,400	N/A	N/A	N/A	N/A	N/A
SS-4 (0188-4)	N/A	N/A	N/A	2.1	<0.5	680	<0.2	10
SS-5 (0188-5)	N/A	N/A	N/A	22	<0.5	1,400	<0.2	10
SW-5 (0188-5W)	0.6	<5	2,800	N/A	N/A	N/A	N/A	N/A
SS-6 (0188-6)	N/A	N/A	N/A	21	<0.5	270	0.7	10
SS-7 (0188-7)	N/A	N/A	N/A	12	0.60	1,000	0.2	10
SW-7 (0188-7W)	11	<5	3,100	N/A	N/A	N/A	N/A	N/A
SS-8 (0188-8)	N/A	N/A	N/A	11	<0.5	1,200	<0.2	10
Old East Ditch								
SS-9 (1088-9)	N/A	N/A	N/A	0.3	<0.5	<10	<0.2	10
SW-9 (0188-9W)	0.2	<5	1,000	N/A	N/A	N/A	N/A	N/A
SS-10 (0188-10)	N/A	N/A	N/A	2.0	0.80	2,850	<0.2	10
SW-10 (0188-10W)	33	<5	3,200	N/A	N/A	N/A	N/A	N/A
Plant NPDES Outfall Ditch								
SW-11 (D-3)++	*	N/A	*	N/A	N/A	N/A	N/A	N/A
SW-11 (D-3A)++	10.7	N/A	13,000	N/A	N/A	N/A	N/A	N/A
SW-12 (D-2)++	1.2	N/A	160	N/A	N/A	N/A	N/A	N/A
SW-13 (D-1)++	6.9	N/A	120	N/A	N/A	N/A	N/A	N/A

Notes:
SS = Surface soil or sediment
SW = Surface water
\+ = The total analysis for SS-2 appears to be anamolous
++ = Samples SW-11 (D-3), SW-12 (D-2), and SW-13 (D-1) taken in February 1988. Sample SW-11 (D-3A) taken in March 1988.
N/A = Sample not analyzed for that parameter
* = Sample broken prior to analysis

TABLE 3-12
HISTORICAL WATER QUALITY DATA AND
DISCHARGE RATES OF TUSCUMBIA SPRINGS*

Date	Specific Conductivity (umhos/cm)	Chloride (mg/l)	Mercury (µg/l)	Cadmium (µg/l)	Discharge (gpm)
08/03/29		1.4			200
12/28/49		1.9			
04/24/50		2.8			
11/30/55		2.8			7,300
04/10/56	224	2.2			
11/23/56	337	4.5			
03/27/60		8.0			29,200
11/16/63		10.5			
05/06/65	282	5.5			
02/07/67	367	8.4			
08/03/67					
10/12/67	371	8.2			
11/03/69	362	8.6			
01/08/74	322	6.2	<0.2	<1	37,700
06/08/82	390	8.2	<0.2	*	
06/10/83	328	4.5	<1	*	
09/17/85	442	21	0.17	*	18,400
10/01/85	445	22	0.09	*	15,900
11/12/85	490	23	0.1	<1	22,200
02/06/86	500	32	0.04	<1	8,710
05/28/86	374	20			22,400
03/19/86	490	31	*	1	26,400
03/21/86	450	30	0.15	2	28,200
11/16/87					12,872
05/02/88	510	1.7	*	<0.5	25,700
11/08/90	500	17	0.2	<0.5	LOW

* = Source: AGS - 1987

TABLE 3-13
REGIONAL GRONDWATER QUALITY DATA
FOR THE TUSCUMBIA LIMESTONE+

Well/Spring	Conductivity (umhos)	Bicarbonate (mg/l)	Chloride (mg/l)	Mercury (µg/l)	Cadmium (ug/l)
Ardmore (A-13)					
1987	193	76	5.2	ND	ND
1988	160	72	3.1	ND	<0.5
Rogersville (T-32)					
1987	186	80	1.7	ND	ND
1988	150	84	6.4	ND	ND
Stevenson (N-40)					
1987	309	170	2.3	ND	2
1988	340	180	2.6	ND	<0.5
Trussville (L-2)					
1987	298	160	1.4	ND	ND
1988	280	160	1.6	ND	ND
Huntsville (N-51)					
1987	341	180	3.3	ND	ND
1988	330	170	3.9	ND	ND
Tuscumbia Springs (M-20)					
1986	374-500	210-240	20-32	ND-0.17	ND-2
MDWS (ADEM/EPA)	500		250	2	5

MDWS = Minimum drinking water standards
ND = Not detected
\+ = Source: AGS - 1988, 1989

TABLE 4-1
HYDRAULIC GRADIENT THROUGH CLAY/CHERT STRATUM*
MAY 1988
Page 1 of 3

Well Cluster Shallow/Deep	Upper Zone Water Level (ft, MSL)	Lower Zone Water Level (ft, MSL)	(a) Thickness of Upper Clay/Chert (ft)	(b) Difference in Cluster Well Water Levels (ft)	Hydraulic Gradient (b/a) (ft/ft)	Gradient Direction
OW-03/OW-36	515.36	508.75	65	6.61	0.10	Downward
OW-5A/OW-6A	520.32	518.00	52	2.32	0.04	Downward
OW-7/OW-8A	515.37	509.35	72	6.02	0.08	Downward
OW-9/OW-10A	517.35	517.36	50	0.01	0	Upward
OW-11/OW-12A	522.99	523.10	52	0.11	0.002	Upward
OW-13/OW-14A	519.75	518.23	55	1.52	0.03	Downward
OW-15A/OW-16	516.17	515.54	52	0.63	0.01	Downward
OW-19/OW-20A	519.26	519.81	89	0.55	0.006	Upward
OW-21/OW-22	519.06	520.26	54	1.20	0.02	Upward
OW-23/OW-24A	519.82	519.88	68	0.06	0.001	Upward
OW-25/OW-26	515.06	514.21	54	0.85	0.02	Downward
OW-27/OW-28	521.06	521.57	56	0.51	0.01	Upward
OW-29/OW-30	516.87	515.37	44	4.00	0.09	Downward
OW-31/OW-32	517.27	519.19	73	1.92	0.02	Upward
OW-33/OW-34	512.02	509.86	49	5.16	0.10	Downward
OW-3/OW-36	510.80	502.56	65	8.24	0.13	Downward
OW-5A/OW-6A	512.65	509.80	52	2.85	0.05	Downward
OW-7/OW-8A	503.58	501.61	72	1.97	0.03	Downward
OW-9/OW-10A	513.64	513.59	50	0.05	0.001	Downward
OW-11/OW-12A	522.53	522.34	52	0.19	0.004	Downward
OW-13/OW-14A	511.76	510.12	55	1.64	0.03	Downward
OW-15A/OW-16	506.32	505.04	52	1.28	0.02	Downward
OW-19/OW-20A	516.17	515.64	89	0.53	0.006	Downward
OW-21/OW-22	516.65	514.58	54	2.07	0.04	Downward
OW-23/OW-24A	514.46	512.09	68	2.37	0.03	Downward

*Based on relationship between water levels in clay/chert and upper limestone.

TABLE 4-1
HYDRAULIC GRADIENT THROUGH CLAY/CHERT STRATUM*
MAY 1988
Page 2 of 3

Well Cluster Shallow/Deep	Upper Zone Water Level (ft, MSL)	Lower Zone Water Level (ft, MSL)	(a) Thickness of Upper Clay/Chert (ft)	(b) Difference in Cluster Well Water Levels (ft)	Hydraulic Gradient (b/a) (ft/ft)	Gradient Direction
OW-25/OW-26	506.54	503.92	54	2.62	0.05	Downward
OW-27/OW-28	512.92	515.25	56	2.33	0.04	Upward
OW-29/OW-30	513.93	511.19	44	2.74	0.06	Downward
OW-31/OW-32	513.64	512.16	73	1.48	0.02	Downward
OW-33/OW-34	510.79	504.11	49	6.68	0.14	Downward
OW-37/OW-38	509.10	503.08	65	6.02	0.09	Downward
OW-39/OW-40	503.35	503.09	49	0.26	0.005	Downward
OW-03/OW-36	511.84	500.93	65	10.91	0.17	Downward
OW-5A/OW-6A	514.76	512.38	52	2.38	0.04	Downward
OW-7/OW-8A	504.65	501.92	72	2.73	0.04	Downward
OW-9/OW-10A	516.55	516.24	50	0.31	0.006	Downward
OW-11/OW-12A	522.67	522.64	52	0.03	0.001	Downward
OW-13/OW-14A	513.15	511.05	55	2.10	0.04	Downward
OW-15A/OW-16	507.32	505.52	52	1.80	0.03	Downward
OW-19/OW-20A	518.91	515.79	89	3.12	0.04	Downward
OW-21/OW-22	518.00	514.44	54	3.56	0.06	Downward
OW-23/OW-24A	518.74	512.52	68	6.22	0.09	Downward
OW-25/OW-26	510.49	504.51	54	5.98	0.11	Downward
OW-27/OW-28	520.00	518.30	56	1.70	0.03	Downward
OW-29/OW-30	514.31	510.31	44	4.00	0.09	Downward
OW-31/OW-32	514.12	511.21	73	2.91	0.04	Downward
OW-33/OW-34	508.98	502.64	49	6.34	0.13	Downward
OW-37/OW-38	509.40	503.34	65	6.06	0.09	Downward
OW-39/OW-40	503.82	503.56	49	0.26	0.005	Downward
OW-45/OW-44	514.20	514.20	45	0.00	0	
OW-47/OW-46	523.09	522.74	50	0.35	0.007	Downward

*Based on relationship between water levels in clay/chert and upper limestone.

TABLE 4-1
HYDRAULIC GRADIENT THROUGH CLAY/CHERT STRATUM*
MAY 1988
Page 3 of 3

Well Cluster Shallow/Deep	Upper Zone Water Level (ft, MSL)	Lower Zone Water Level (ft, MSL)	(a) Thickness of Upper Clay/Chert (ft)	(b) Difference in Cluster Well Water Levels (ft)	Hydraulic Gradient (b/a) (ft/ft)	Gradient Direction
OW-49/OW-48	523.16	521.39	47	1.77	0.04	Downward
OW-51/OW-50	525.43	523.16	56	2.27	0.04	Downward
OW-53/OW-52	523.92	519.26	56	4.66	0.04	Downward
OW-3/OW-36	517.66	509.90	65	7.76	0.12	Downward
OW-5A/OW-6A	524.62	520.71	52	3.91	0.08	Downward
OW-7/OW-8A	519.68	515.94	72	3.74	0.05	Downward
OW-9/OW-10A	520.82	520.71	50	0.11	0.002	Downward
OW-11/OW-12A	523.23	523.70	52	0.47	0.009	Upward
OW-13/OW-14A	525.18	524.60	55	0.58	0.01	Downward
OW-15A/OW-16	523.81	533.19	52	9.38	0.18	Upward
OW-19/OW-20A	520.49	522.32	89	1.83	0.02	Upward
OW-21/OW-22	519.95	522.13	54	2.18	0.04	Upward
OW-23/OW-24A	521.17	523.20	68	2.03	0.03	Upward
OW-25/OW-26	527.36	522.08	54	5.28	0.10	Downward
OW-27/OW-28	527.45	524.24	56	3.21	0.06	Downward
OW-29/OW-30	518.43	520.21	44	1.78	0.04	Upward
OW-31/OW-32	518.80	521.45	73	2.65	0.04	Upward
OW-33/OW-34	516.51	511.56	49	4.95	0.10	Downward
OW-37/OW-38	519.22	517.96	65	1.26	0.02	Downward
OW-39/OW-40	519.91	519.07	49	0.84	0.02	Downward
OW-45/OW-44	519.05	518.36	45	0.69	0.02	Downward
OW-47/OW-46	523.90	524.56	50	0.66	0.01	Upward
OW-49/OW-48	527.30	524.76	47	2.54	0.05	Downward
OW-51/OW-50	525.43	523.16	56	2.27	0.04	Downward
OW-53/OW-52	517.61	ARTESIAN	68			
OW-55/OW-54	517.92	517.77	57	0.15	0.003	Downward
OW-57/OW-56	512.68	511.92	69	0.76	0.01	Downward

*Based on relationship between water levels in clay/chert and upper limestone.

Observation Well UZ/LZ	Boring Number	Depth to Limestone	Top of Limestone (MSL)	Depth Into Limestone	Descript
5A/6A	B-2	52	474	8	Gray lime recircula
7/8A	B-1	71.5	450	5	Gray lime
9/10A	B-3	49.5	471	5.5	Gray lime
11/12A	B-8	52	475	6	Gray lime
13/14A	B-5	55	476	5	Gray lime
15A/16	WCC	51.5	476	9	Not Avail
19/20A	B-7	89	431	7.5	Gray lime recovered
21/22	WCC	54	466	9.2	Not Avail
23/24A	B-6	68	454	7	Gray lime
25/26	B-4	54	480	7.5	Gray lime recircula
27/28	B-13	56	477	9	Gray lime
29/30	B-9	44.5	478	7.5	Gray lime recircula
31/32	B-10	73	449	8	Gray lime large voi
33/34	B-11	49	474	7.5	Gray lime
36	B-12	65	454	8	Gray lime recircula
37/38	B-14	65	459	9.5	Gray lime 96% recov
39/40	B-15	49	473	9.5	Gray limes 93% recove
45/44	B-18	45	477	8	Gray limes 4.7 ft of recovery
47/46	B-19	50	478	7.5	Gray limes recovery
49/48	B-20	47	482	7	Gray limes recovery
51/50	B-21	56	473	7.5	Gray limes recovery
53/52	B-32	68	458	9	Gray limes recovery
55/54	B-33	56.5	468	7.5	Gray limes recovery
57/56	B-34	69	457	8	Gray limes recovery
59/58	B-35	53.5	473	6	Gray limes recovery
61/60	B-36	55.0	472	6.5	Gray limes recovery

*Soil sample immediately above limestone
**Unfiltered water sample from Lower Zone (top of limestone) monitor wel
***Upper Zone companion well to Lower Zone well

+Concentration is the average between four replicates

NA - Not Available

Notes:
1. Upper Zone well 43 originally intended as a lower zone well
2. WCC - Woodward-Clyde Consultants installed OW-16 and OW-22
3. Values stated are for unfiltered samples taken in April 199

TABLE 4-2

MMARY OF HYDROGEOLOGICAL DATA
) REPRESENTATIVE ANALYTICAL DATA

TABLE 8-1
SUMMARY OF HAND AUGER BORING DETAILS

Hand Auger Number	Total Depth (ft)	Purpose	Observations
AB-1	6.0	Define clay cap thickness	Clay cap to 1.5', waste to depth of boring
AB-2	11.0	Define clay cap thickness	Clay cap to 2.0', waste to 8.0', and native soil thereafter to depth of boring
AB-3	5.0	Define clay cap thickness	Clay cap to 3.5', salt crystals to depth of boring
AB-4	9.0	Define clay cap thickness	Clay cap to depth of boring
AB-5	14.0	Define clay cap thickness	Clay cap to 2.0', waste to 8.0', salt crystals to 11.0', waste to depth of boring
AB-6	6.0	Define clay cap thickness	Clay cap to 6.0', waste noted just below 6.0'
AB-7	6.0	Define clay cap thickness	Clay cap to depth of boring
AB-8	6.0	Define clay cap thickness	Clay cap to depth of boring
W-1	5.0	Determine west limit of waste fill	Native soil with black beads interbedded*
W-1A	5.0	Identify the limits of the black beaded material	Native soil with black beads interbedded*
W-1B	14.0	Identify the limits of the black beaded material	Native soil with black beads interbedded*
W-1C	6.0	Identify the limits of the black beaded material	Native soil with black beads interbedded*
W-1D	6.0	Identify the limits of the black beaded material	Native soil with black beads interbedded*
W-2	5.0	Determine west limit of waste fill	Native soil to depth of boring
W-3	5.0	Determine west limit of waste fill	Native soil to depth of boring
W-4	5.0	Determine west limit of waste fill	Native soil to depth of boring
W-5	5.0	Determine west limit of waste fill	Native soil to depth of boring
W-6	5.0	Determine west limit of waste fill	Native soil to depth of boring
W-7	5.0	Determine west limit of waste fill	Native soil to depth of boring

*Determined to be natural deposits. See Figures 8-1 and 8-2 for location.

TABLE 8-2
MARCH 1990 GROUNDWATER DATA FROM LANDFILL AREA

Temporary Piezometer	Top-of-Casing	Surface Elevation	Elevation of Native Soil	Groundwater Elevation 05/16/89	06/09/89	09/29/89	01/20/90	02/27/90	03/27/90
TP-1	542.59	539.80	529.3	528.9	529.1	528.6	527.7	527.6	527.9
TP-2	534.30	531.88	531.9	532.4	532.5	529.7	529.3	528.9	528.8
TP-3	539.90	536.90	526.4	525.4	526.2	525.8	525.4	527.7	526.8
TP-4	536.80	533.80	<518.3**	526.7	528.9	526.4	531.3**	528.9	528.8
TP-5	532.58	530.00	530.0	529.7	529.5	529.0	529.5	529.8	529.7
TP-6	533.22	530.30	522.3	523.6	523.6	523.3	523.9	523.8	523.7
TP-7	536.90	533.90	523.9	525.0	524.3	523.9	523.5	523.9	523.8
TP-8	533.83	531.00	524.5	528.5	527.8	526.7	DRY	523.9	523.8
TP-9	530.90	527.90	522.9	523.7	523.9	523.3	523.2	522.0	521.8
TP-10	530.80	527.80	527.7	523.7	527.8	526.9	526.3	524.9	524.7
TP-11	531.00	529.50	529.5	NE	526.1	526.0	526.4	525.5	525.5
TP-12	522.32	520.61	520.6	NE	522.0	521.0	522.0	522.0	521.9

NE = Not in existence.

*Boring was initiated at 533.8 feet and terminated at a depth of 15.5 feet. Native soil was not encountered.
**This value appears anomalous.

TABLE 8-3
LABORATORY RESULTS OF ANALYSES OF GROUNDWATER SAMPLES
FROM TEMPORARY PIEZOMETERS - MAY 1989

Temporary Piezometer	Mercury (µg/l)	Cadmium (µg/l)	Chloride (mg/l)
TP-1	290	<5	5,800
TP-2	0.3	<5	2,300
TP-3	180	6	66,000
TP-4	<0.2	<5	2,000
TP-5	<0.2	<5	16,800
TP-6	2.0	<5	8,400
TP-7	1.1	7	13,400
TP-8	0.6	<5	340
TP-9	0.6	<5	2,300
TP-10	0.9	<5	42

TABLE 8-4
LABORATORY RESULTS OF MERCURY ANALYSES OF
SOIL SAMPLES NEAR PROPOSED SLURRY WALL - JULY 1989

Boring	Total Mercury (mg/kg)	Extractable Mercury (mg/l)
SW-1A	0.13	Not Analyzed
SW-2	0.15	Not Analyzed
SW-3	0.55	Not Analyzed
SW-4	3.8	Not Analyzed
SW-5	65	0.0007
SW-6	0.04	Not Analyzed
SW-7	11	0.0003

TABLE 8-5
LANDFILL (SWMU 1) SAMPLING/ANALYSIS

Inner Ring* Clusters**	Outer Ring* Clusters
OW-13/OW-14A	
	OW-15A/OW-16
OW-19/OW-20A	
OW-21/OW-22	
OW-23/OW-24A/DOW-2	
	OW-25/OW-26
	OW-31/OW-32
	OW-52/OW-53/DOW-3

*Inner ring and outer ring clusters will be sampled and analyzed for Hg, Cd, and Cl according to the Groundwater Monitoring Plan Schedule provided in Volume III

**Inner ring clusters will be sampled and analyzed for PCB during the first sampling event following RFI Work Plan approval

TABLE 10-1
SUMMARY OF LABORATORY RESULTS
WOODWARD-CLYDE INVESTIGATION
FORMER NORTH IMPOUNDMENT BASIN
PAGE 1 OF 3

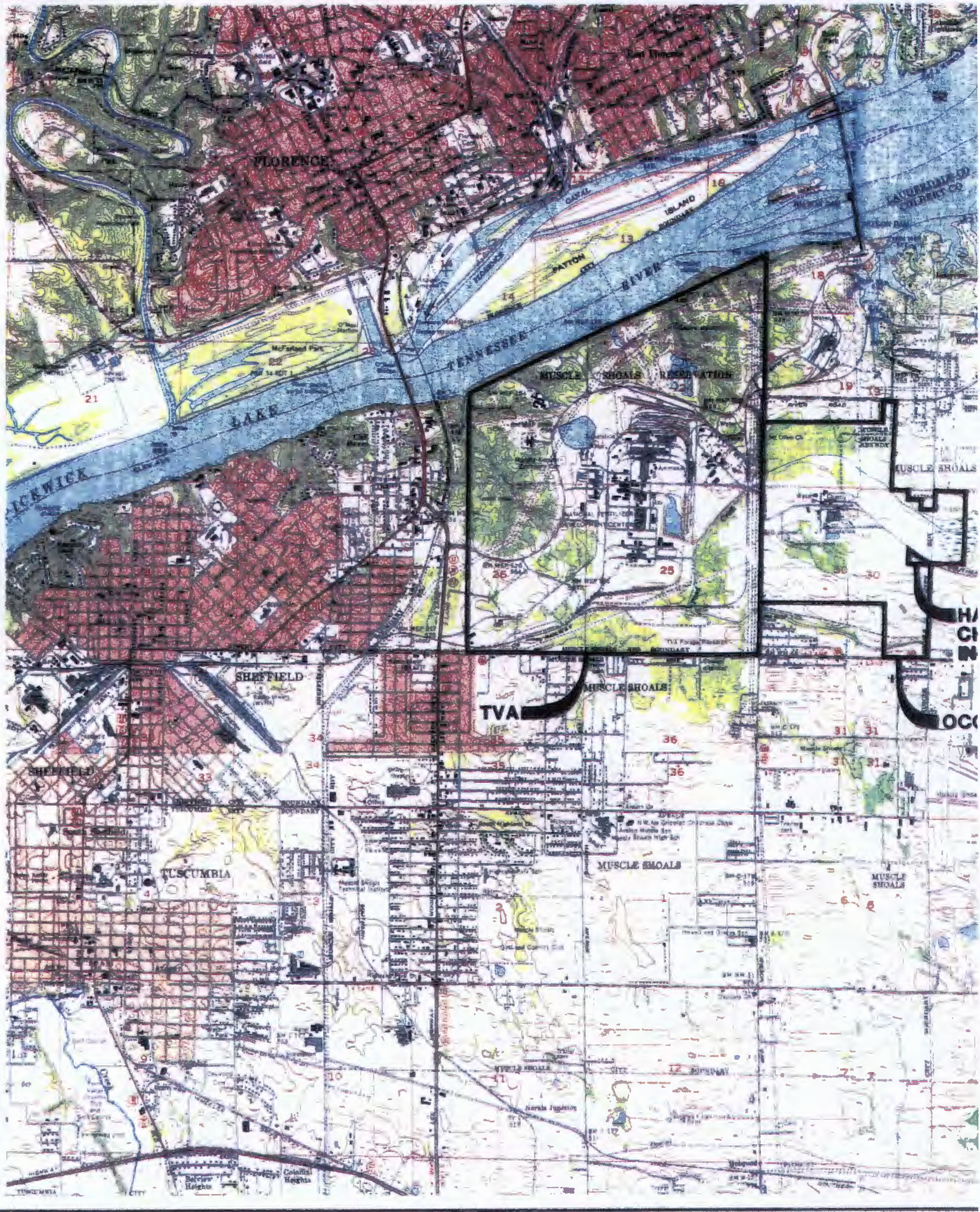
Sample ID	Depth	EP Tox Cadmium (mg/l)	EP Tox Mercury (mg/l)
1-2-L	0 - 1	<0.013	0.0004
1-1-S	0 - 1	<0.07	0.0014
1-1-S	1 - 2	<0.07	<0.0007
1-2-L	1 - 2	<0.013	<0.0002
1-2-L	2 - 3	<0.013	<0.0002
1-3-S	0 - 1	<0.07	<0.0007
1-3-S	1 - 1.5	<0.07	<0.0007
1-4-L	0 - 1	<0.03	<0.002
1-4-L	1 - 2	<0.03	<0.002
1-6-L	0 - 1	<0.07	<0.0007
1-6-L	1 - 2	<0.07	<0.0007
2-3-L	0 - 1	<0.03	<0.002
2-3-L	1 - 2	<0.03	<0.002
2-4-L	0 - 1	<0.07	<0.0007
2-4-L	1 - 2	<0.07	<0.0007
2-5-S	0 - 1	<0.07	<0.0007
2-5-S	1 - 2	<0.07	<0.0007
2-6-S	0 - 1	<0.07	0.0012
2-6-S	1 - 2	<0.07	<0.0007
3-1-L	0 - 1	<0.03	<0.002
3-1-L	1 - 2	<0.03	<0.002
3-2-S	0 - 1	<0.07	<0.0007
3-2-S	1 - 2	<0.07	<0.0007
3-3-L	0 - 1	<0.03	<0.002
3-3-L	1 - 2	<0.03	<0.002
3-4-L	0 - 1	<0.03	<0.002
3-4-L	1 - 2	<0.03	<0.002
3-4-L	2 - 3	<0.03	<0.002
3-4-L	3 - 4	<0.03	<0.002
4-2-S	0 - 1	<0.03	<0.002
4-2-S	1 - 2	<0.03	<0.002
4-5-L	0 - 1	<0.013	<0.0002
4-5-L	1 - 2	<0.013	<0.0002
4-5-L	2 - 3	<0.013	<0.0002
4-3-L	0 - 1	<0.07	<0.0007
4-3-L	1 - 2	<0.07	<0.0007
4-3-L	2 - 2.5	<0.07	<0.0007
4-4-L	0 - 1	<0.07	0.0057
4-4-L	1 - 2	<0.07	0.0057
4-4-L	2 - 3	<0.07	0.0057
4-4-L	0 - 1	<0.07	0.0057
5-4-L	1 - 2	<0.07	0.0057
5-5-S	0 - 1	<0.07	<0.0007

TABLE 10-1
SUMMARY OF LABORATORY RESULTS
WOODWARD-CLYDE INVESTIGATION
FORMER NORTH IMPOUNDMENT BASIN
PAGE 2 OF 3

Sample ID	Depth	EP Tox Cadmium (mg/l)	EP Tox Mercury (mg/l)
5-5-S	1 - 2	<0.07	<0.0007
7-4-S	0 - 1	<0.07	<0.0007
7-4-S	1 - 2	<0.07	<0.0007
7-4-L	0 - 1	<0.07	<0.0007
7-4-L	1 - 1.5	<0.07	<0.0007
7-5-L	0 - 1	<0.07	0.0038
7-5-L	1 - 2	<0.07	<0.0007
7-5-L	2 - 2.5	<0.07	<0.0007
7-6-L	0 - 1	<0.03	<0.002
7-6-L	1 - 2	<0.03	<0.002
8-1-L	0 - 1	<0.07	<0.0007
8-1-L	1 - 1.5	<0.07	<0.0007
8-4-L (9/23/80)	0 - 1	<0.013	<0.0002
8-4-L (8/3/81)	0 - 1	<0.07	<0.0007
8-4-L (9/23/80)	1 - 2	<0.013	<0.0002
8-4-L (8/3/81)	1 - 2	<0.07	<0.0007
9-1-L	0 - 1	<0.03	<0.002
9-1-L	1 - 2	<0.03	<0.002
9-2-L	0 - 1	<0.03	<0.002
9-2-L	1 - 2	<0.03	<0.002
9-2-L	2 - 3	<0.03	<0.002
9-3-L	0 - 1	<0.03	<0.002
9-3-L	1 - 2	<0.03	<0.002
9-4-L	0 - 1	<0.07	<0.0007
9-4-L	1 - 2.5	<0.07	<0.0007
10-1-L	0 - 1	<0.07	<0.0007
10-1-L	1 - 2	<0.07	<0.0007
10-1-L	2 - 2.5	<0.07	<0.0007
11-3-L	0 - 1	<0.07	<0.0007
12-1-L	0 - 1	<0.03	<0.002
12-1-L	1 - 2	<0.03	<0.002
12-2-S	0 - 1	<0.07	<0.0007
12-3-S	0 - 1	<0.03	<0.002
13-1-S	0 - 1	<0.07	<0.0007
13-2-L	0 - 1	<0.013	<0.0002
13-2-L	1 - 2	<0.013	<0.0002
13-3-L	0 - 13.5	<0.07	<0.0007
13-4-S	0 - 1	<0.03	<0.002
13-5-L	0 - 1	<0.07	0.0023
13-6-S	0 - 1	<0.03	<0.002
14-1-S	0 - 1	<0.07	<0.0007
14-2-L	0 - 1	<0.07	<0.0007
14-3-S	0 - 1	<0.03	<0.002

TABLE 10-1
SUMMARY OF LABORATORY RESULTS
WOODWARD-CLYDE INVESTIGATION
FORMER NORTH IMPOUNDMENT BASIN
PAGE 3 OF 3

Sample ID	Depth	EP Tox Cadmium (mg/l)	EP Tox Mercury (mg/l)
14-5-S	0 - 1	<0.07	<0.0007
14-6-S	0 - 1	<0.07	<0.0007
15-1-L	0 - 1	<0.03	<0.002
15-1-L	1 - 2	<0.03	<0.002
15-3-S	0 - 0.5	<0.07	<0.0007
15-4-L	0 - 1	<0.03	<0.002
15-4-L	1 - 2	<0.002	<0.002
15-5-S	0 - 1	<0.07	<0.0007
15-6-L	0 - 1	<0.002	<0.002
16-1-L	0 - 1	<0.07	<0.0007
16-2-L	0 - 1	<0.03	<0.002
16-3-S	0 - 1	<0.07	<0.0007
16-4-L	0 - 1	<0.013	<0.0002
16-4-L	1 - 2	<0.013	<0.0002
16-5-S	0 - 1.2	<0.07	<0.0007
17-1-S	0 - 1	<0.07	<0.0007
17-2-S	0 - 1	<0.03	<0.002
17-3-L	0 - 1	<0.07	0.0015
17-3-L	1 - 1.5	<0.07	<0.0007
17-4-S	0 - 1	<0.07	0.0012
18-1-S	0 - 1	<0.07	<0.0007



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APPROVED BY		6/25/92
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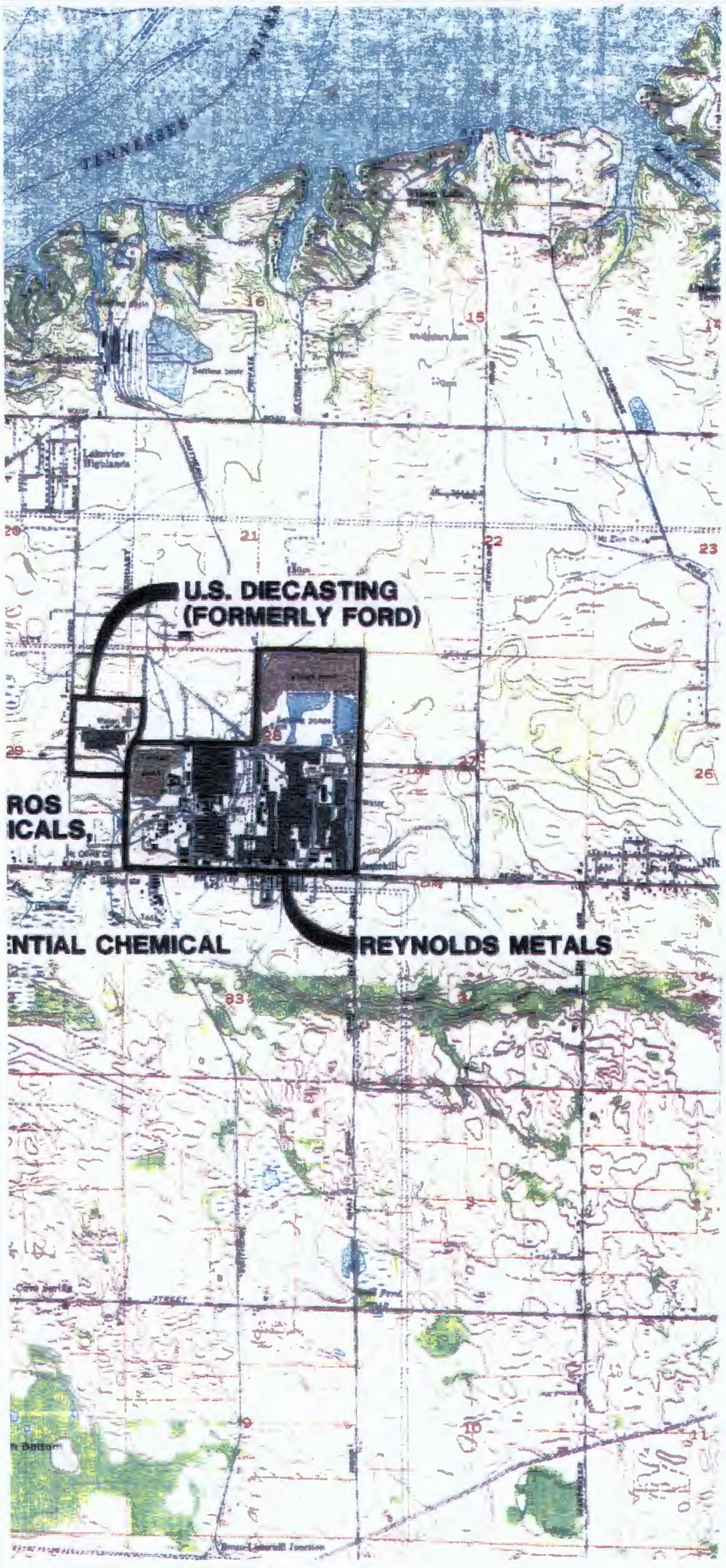

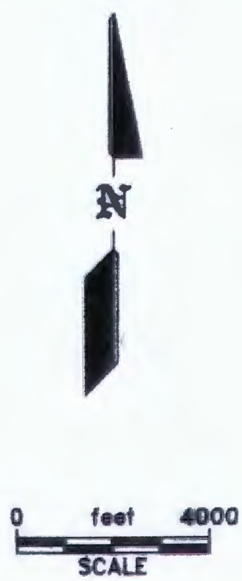

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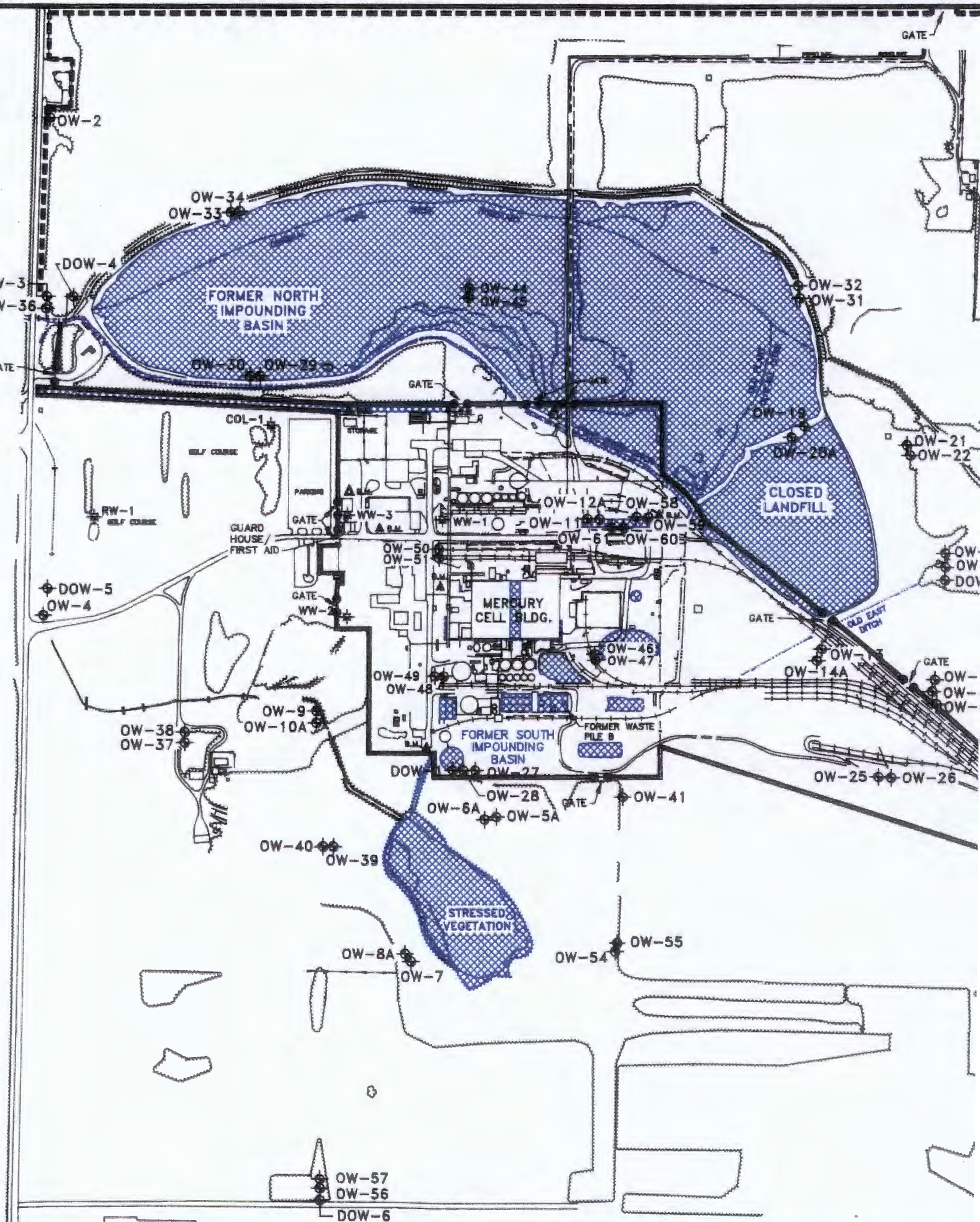
G&E ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

VICINITY MAP

1-1
Fig. No.



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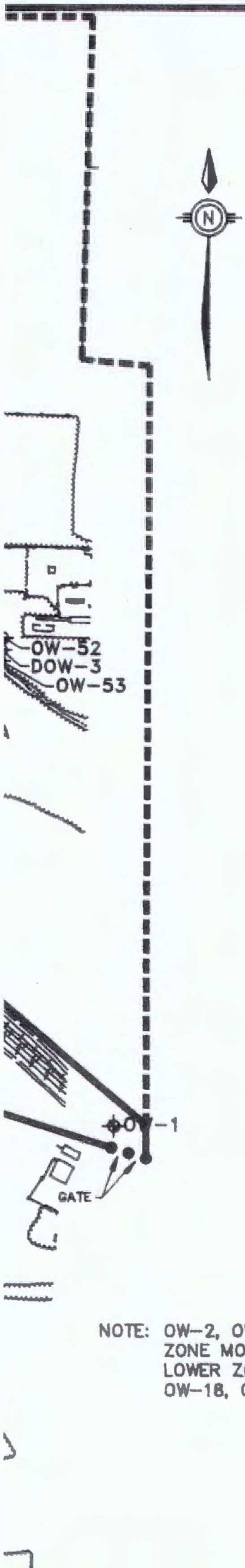

LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- BARBED WIRE FENCE
- 8 FOOT CHAIN-LINK FENCE WITH 3-STRAND BARBED-WIRE
- OLD BENCH MARK
- NEW BENCH MARK
- SOLID WASTE MANAGEMENT UNIT (SWMU) OR AREA OF CONCERN (AOC)

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

0 feet 600
SCALE

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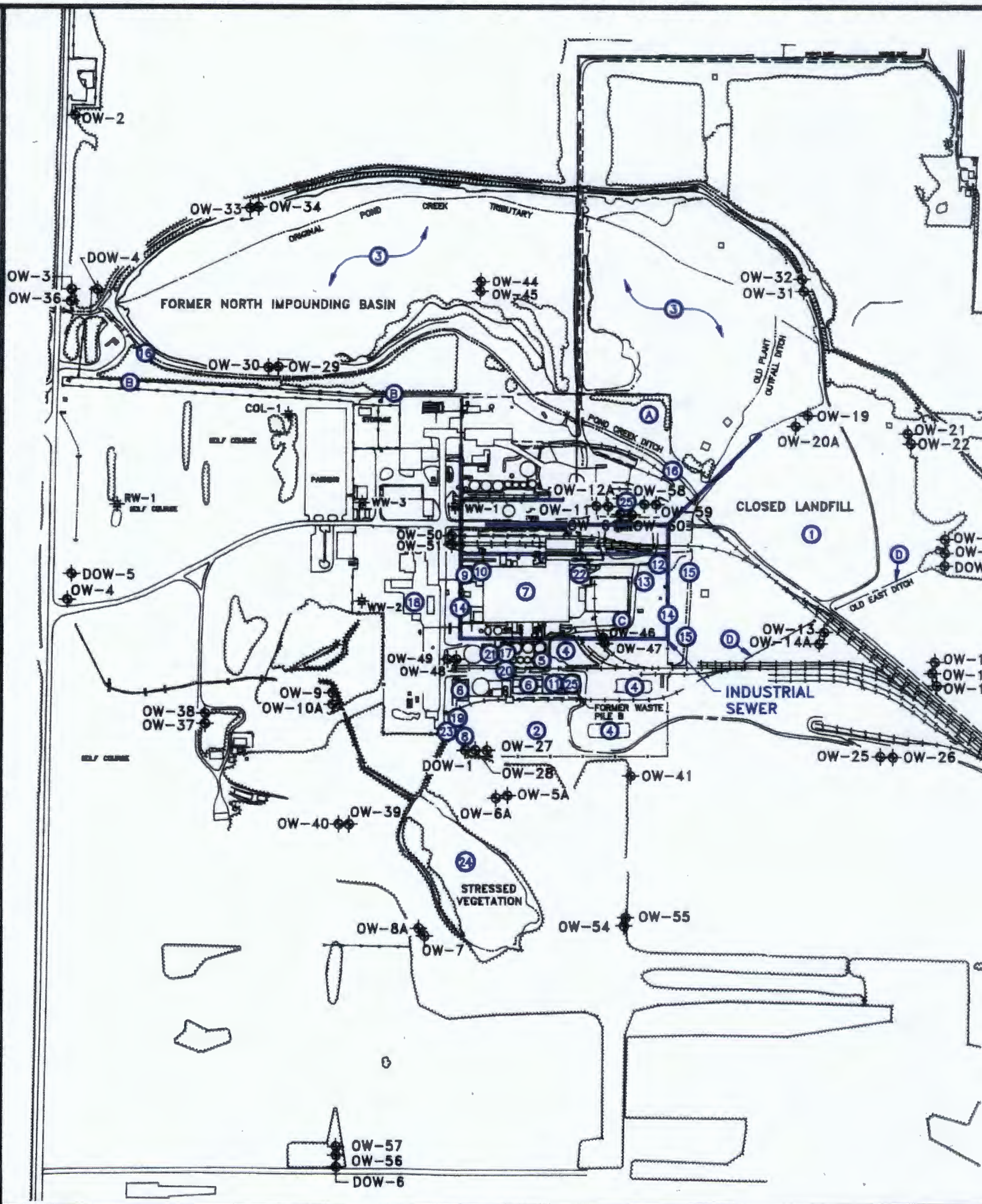
OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**SITE PLAN**	**1-2** Fig. No.



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	SWMU/AOC	Type of Unit
1	Landfill	Landfill
2	Former South Impounding Basin	Surface Impoundment
3	Former North Impounding Basin	Surface Impoundment
4	Salt Storage Piles	Bulk Product Storage
5	Brine Filter Backwash Collection Tank	Tank
6	Sludge Pads	Waste Storage Area
7	Mercury Cell Room Trench System	Trenches/sump
8	Former Hypalon-Lined Storage Tank Location	Tank
9	Mercury Retort Tanks	Tanks
10	Mercury Collection Vessel	Tanks
11	Hazardous Waste Roll-Off Pad	Storage Pad
12	Emergency Chlorine Scrubber Tanks	Tanks
13	Scrubber Solution Treatment Tanks	Tanks
14	Industrial Sewer System	Sewer System
15	Old East Outfall Ditch	Ditch
16	NPDES Outfall Ditch	Ditch
17	Wastewater Treatment Frame Filter Presses	Filters
18	Former PCB Storage Area	Temporary Storage
19	500,000-gallon Wastewater Storage Tank	Tank
20	Wastewater Treatment Hydrazine Reaction Tank	Tank
21	Wastewater Treatment Carbon Polishing Towers	Tank
22	Carbon Tetrachloride Stripper	Tank
23	Southern Stormwater Discharge Ditch	Ditch
24	Stressed Vegetation Area South of Former South Impounding Basin	Discharge Area
25	Waste Pile Storage Areas	Waste Piles
A	Junkyard	Storage Area
B	Old TVA Pipeline Right-of-Way	Right-of-Way
C	Gravel Areas Adjacent to Electrical Substation	Surface Spill
D	Old East Ditch	Earthen Ditch

LEGEND

- ◆ MONITOR WELL LOCATION
- ✦ WATER WELL (ABANDONED/CLOSED)
- ① SWMU LOCATION
- Ⓐ AOC LOCATION

NOTE: OW–2, OW–4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW–17, OW–18, OW–35, OW–42 AND OW–43 NOT USED.

0 feet 600
SCALE

G&E
ENGINEERING, INC.
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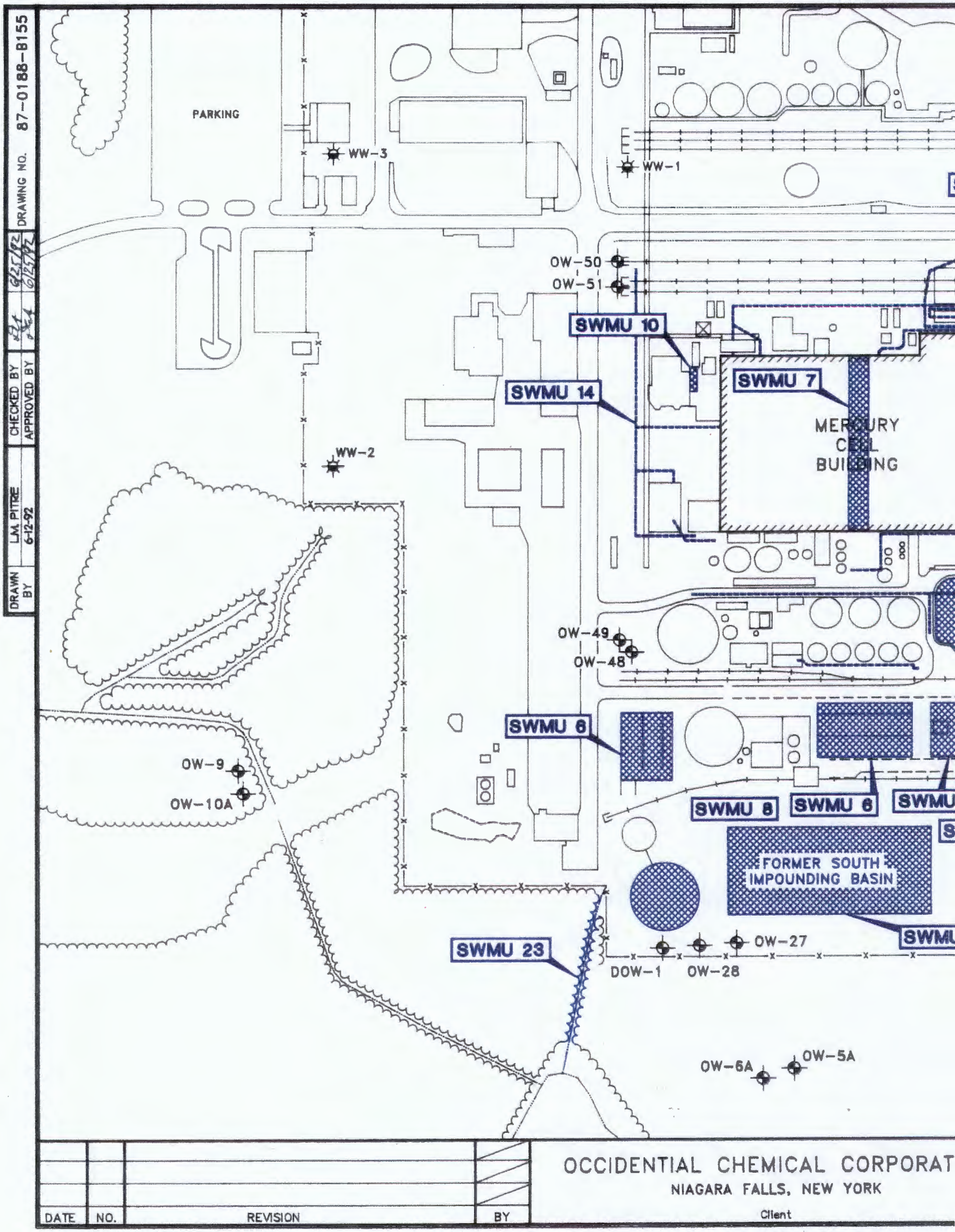
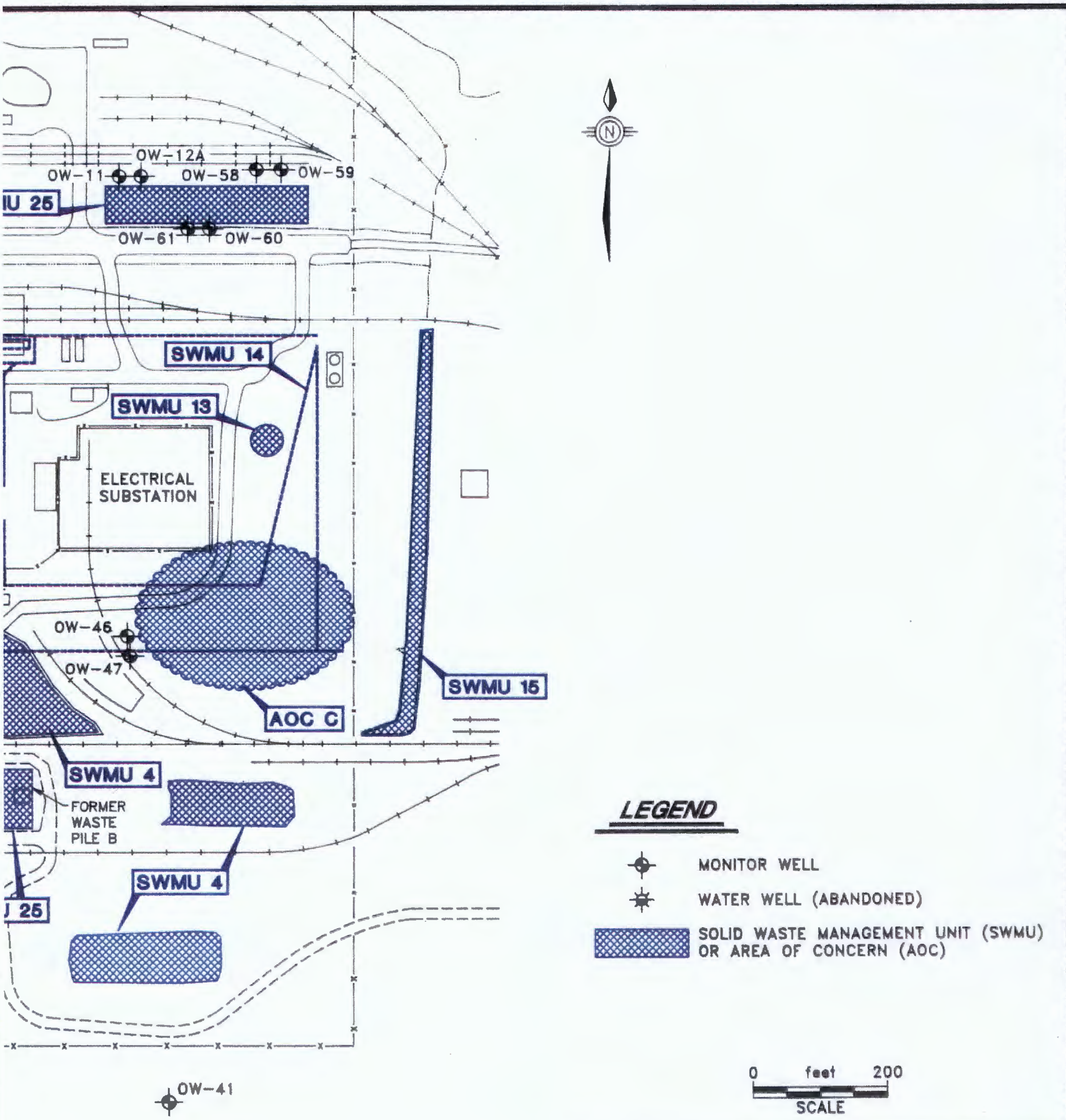
OCCIDENTAL CHEMICAL
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

SWMU-AOC LOCATION MAP

1-3
Fig. No.


DRAWING NO. 87-0188-B155
CHECKED BY
APPROVED BY
DRAWN BY
LM PITRE
6-12-92
PARKING
WW-3
WW-1
WW-2
OW-50
OW-51
SWMU 10
SWMU 14
SWMU 7
MERCURY CELL BUILDING
OW-49
OW-48
SWMU 6
SWMU 8
SWMU 6
SWMU
OW-9
OW-10A
FORMER SOUTH IMPOUNDING BASIN
SWMU 23
OW-27
DOW-1
OW-28
OW-6A
OW-5A
DATE
NO.
REVISION
BY
OCCIDENTIAL CHEMICAL CORPORAT
NIAGARA FALLS, NEW YORK
Client



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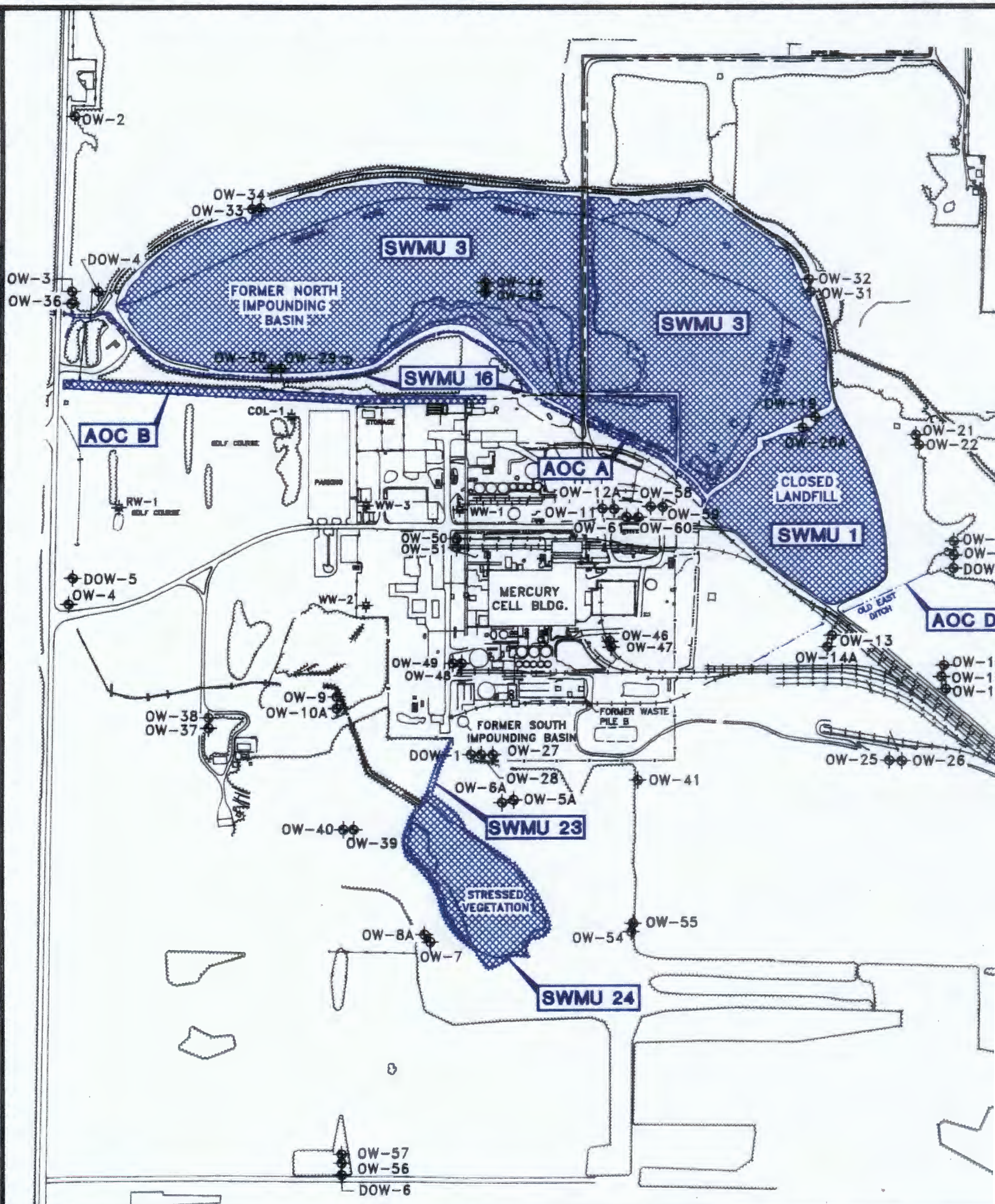
ENVIRONMENTAL CONSULTANTS

OCCIDENTIAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**SWMU-AOC LOCATION PLAN I RFI REQUIRED**	**1-4** Fig. No.



DRAWN BY	L.M.PITRE	6-11-92
CHECKED BY		6/25/92
APPROVED BY		6/25/92
DRAWING NO.	87-0188-B168	

DATE	NO.	REVISION	BY

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NIAGARA FALLS, NEW YORK

Client

LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- SOLID WASTE MANAGEMENT UNIT (SWMU) OR AREA OF CONCERN (AOC)

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

0 feet 800
SCALE

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CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

SWMU-AOC
LOCATION PLAN II
RFI REQUIRED

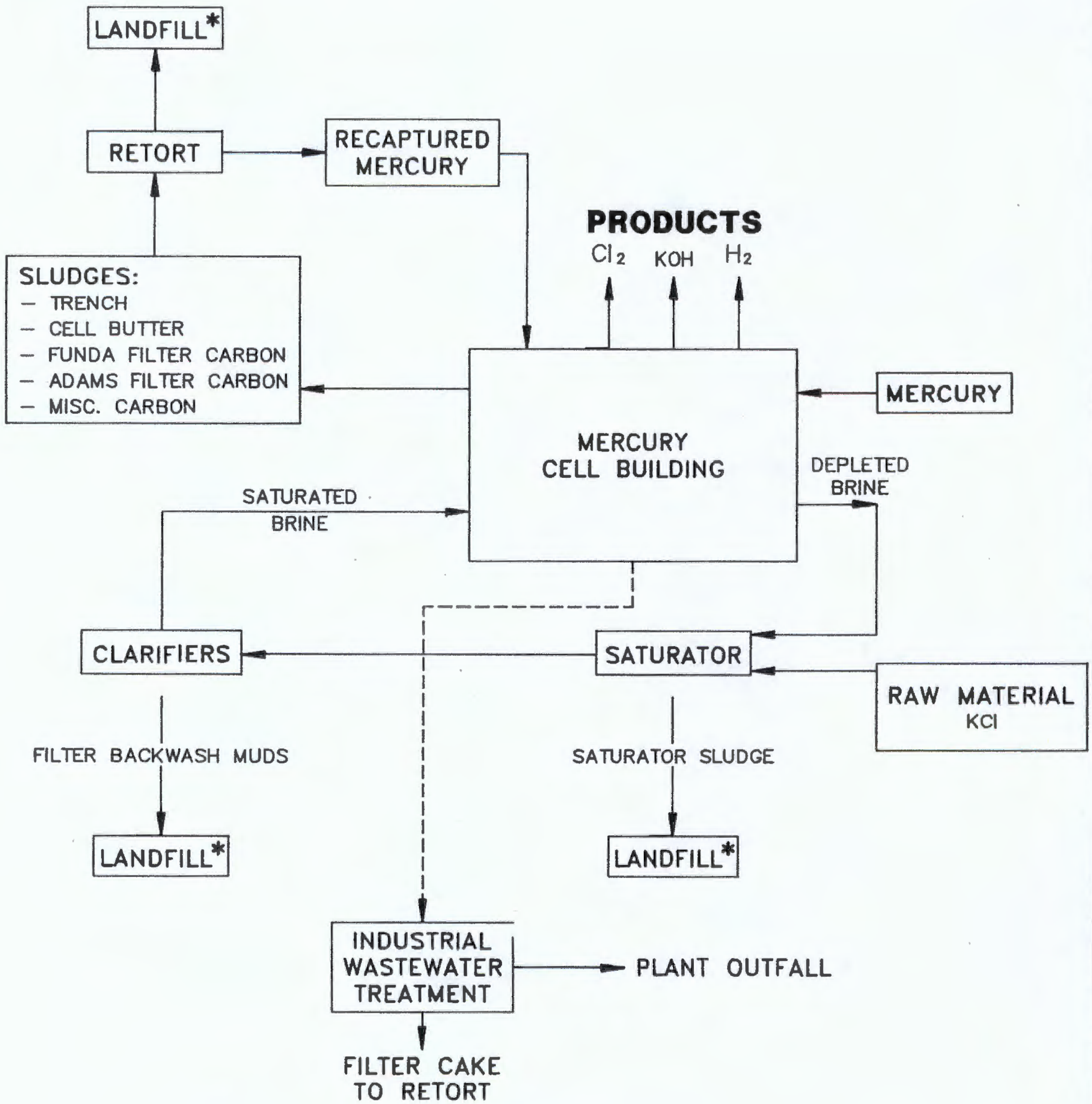
1-5
Fig. No.

G & E ENGINEERING, INC.

Approximate Scale:
1" = 1000'

Aerial Photograph
February 10, 1988

Figure
2-1



* ALL LANDFILLED SOLID WASTES WERE TRANSPORTED OFF-SITE TO EMILE, ALABAMA BEGINNING FEBRUARY 1980.

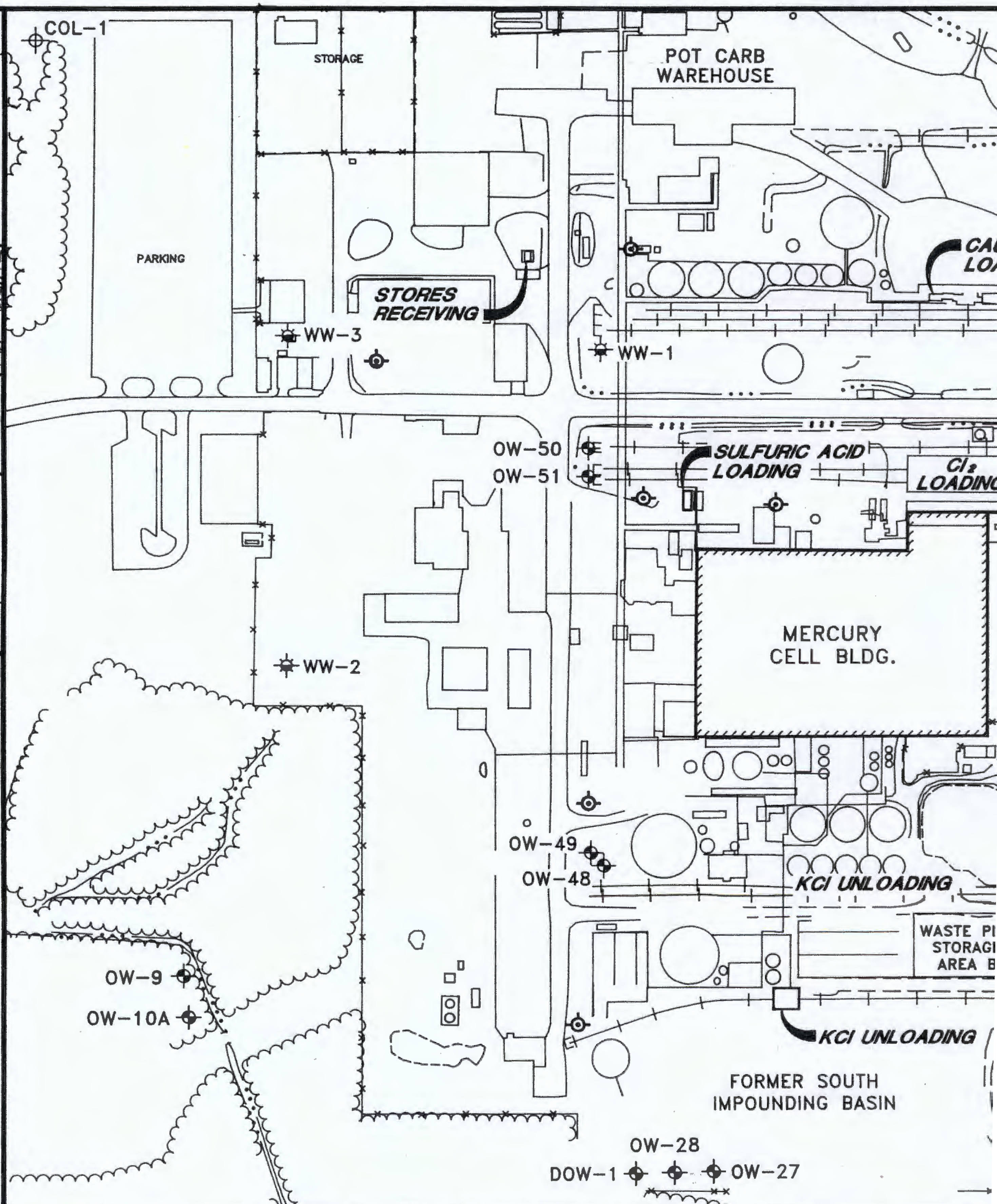
ABL Drawn by	DEA Ckd. by	4-27-92 Date	0188-A178 File No.	G&E ENGINEERING, INC. ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CORP.
NIAGARA FALLS, NEW YORK
Client

OCCIDENTAL CHEMICAL
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

SIMPLIFIED CHLOR-ALKALI PROCESS FLOW DIAGRAM

2-2
Fig. No.



DRAWN BY	L.M.PITRE 6-5-92
CHECKED BY	6/25/92
APPROVED BY	6/25/92
DRAWING NO.	87-0188-B140

DATE	NO.	REVISION	BY

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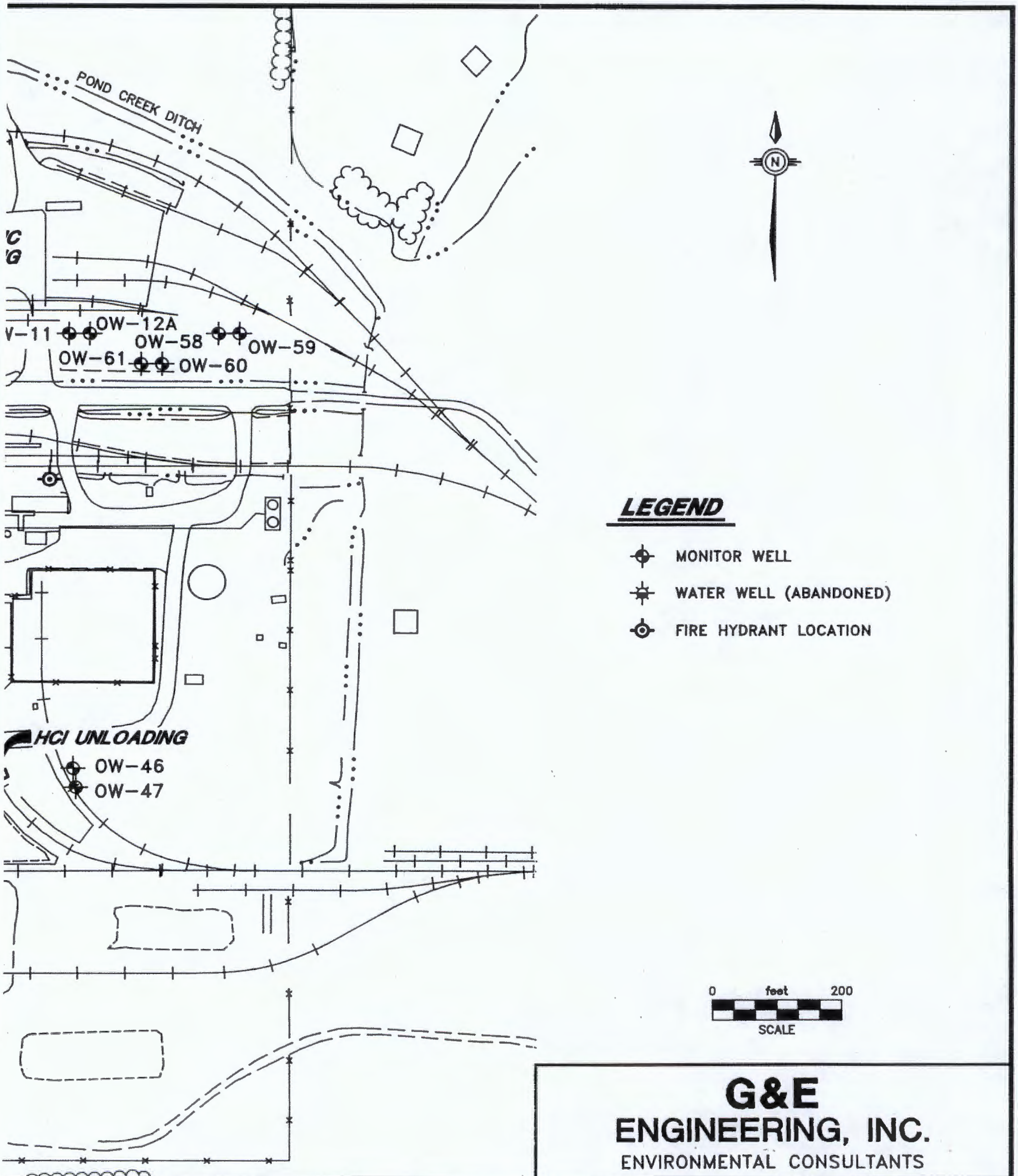
NIAGARA FALLS, NEW YORK

Client



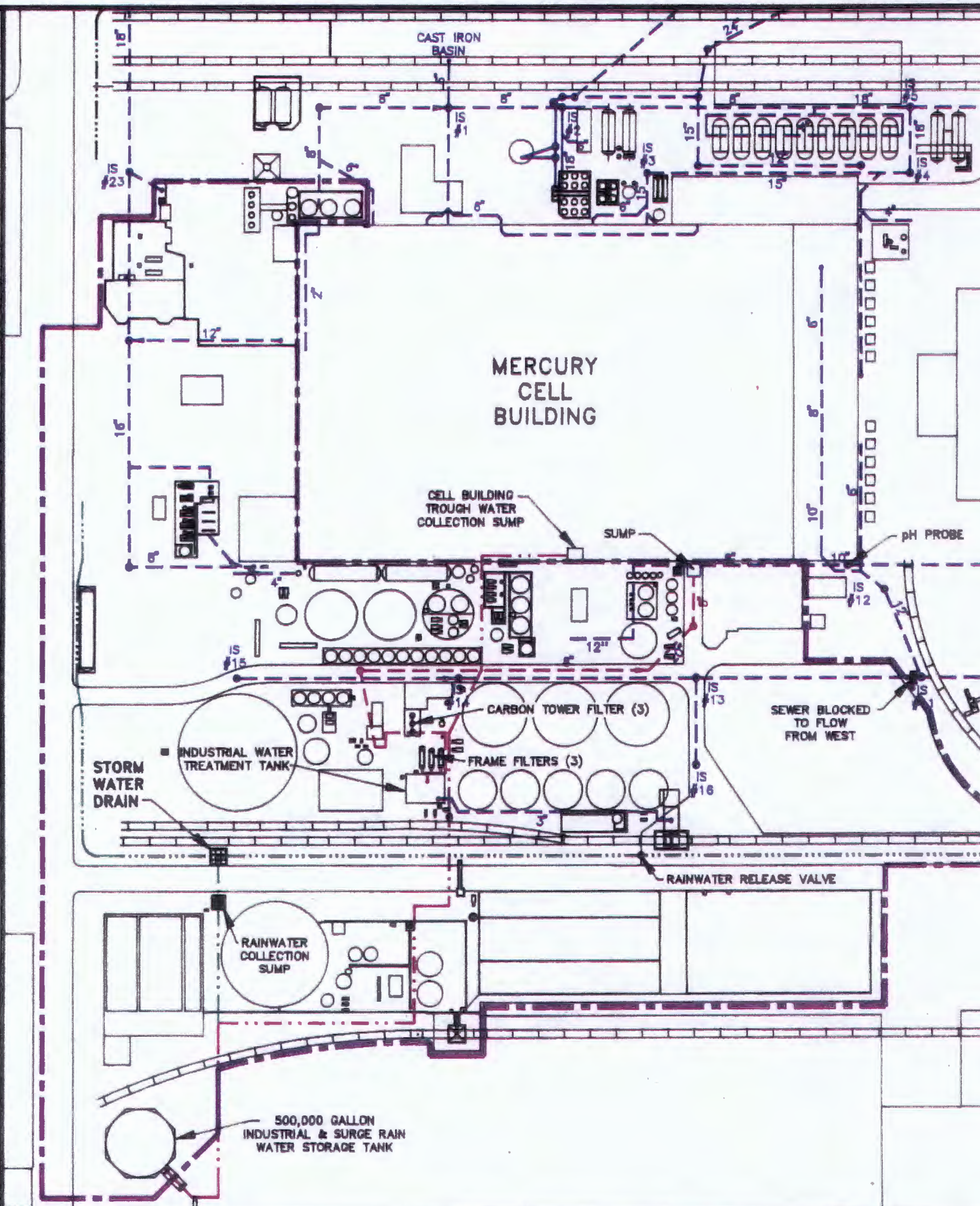
G&E ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

FIRE CONTROL AND SHIPPING/RECEIVING LOCATION PLAN

2-3
Fig. No.

DRAWN BY	L.M.PITRE 4-28-92	CHECKED BY / APPROVED BY	6/25/92 6/25/92	DRAWING NO.	87-0188-B141

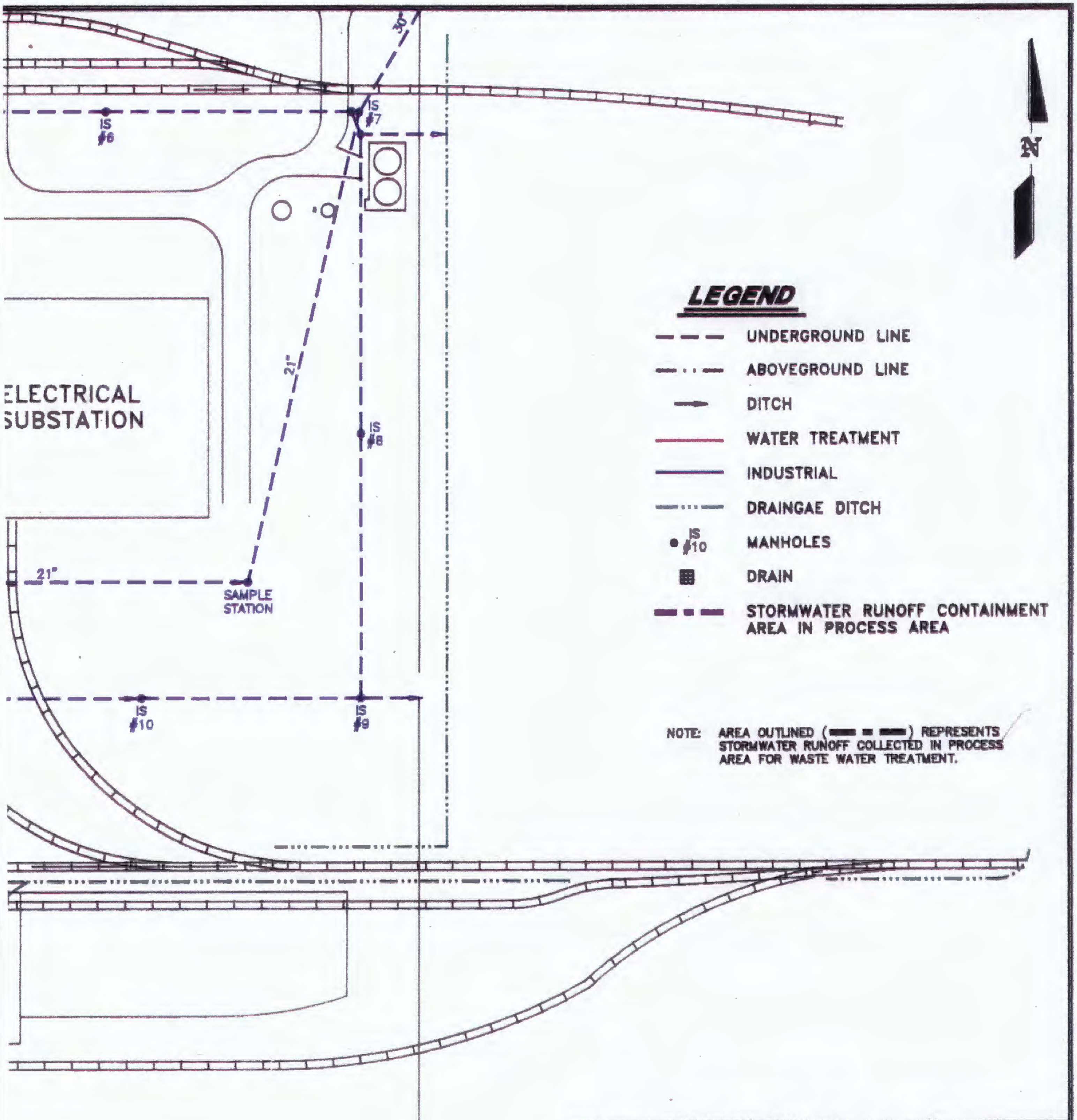


DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATI

NIAGARA FALLS, NEW YORK

Client



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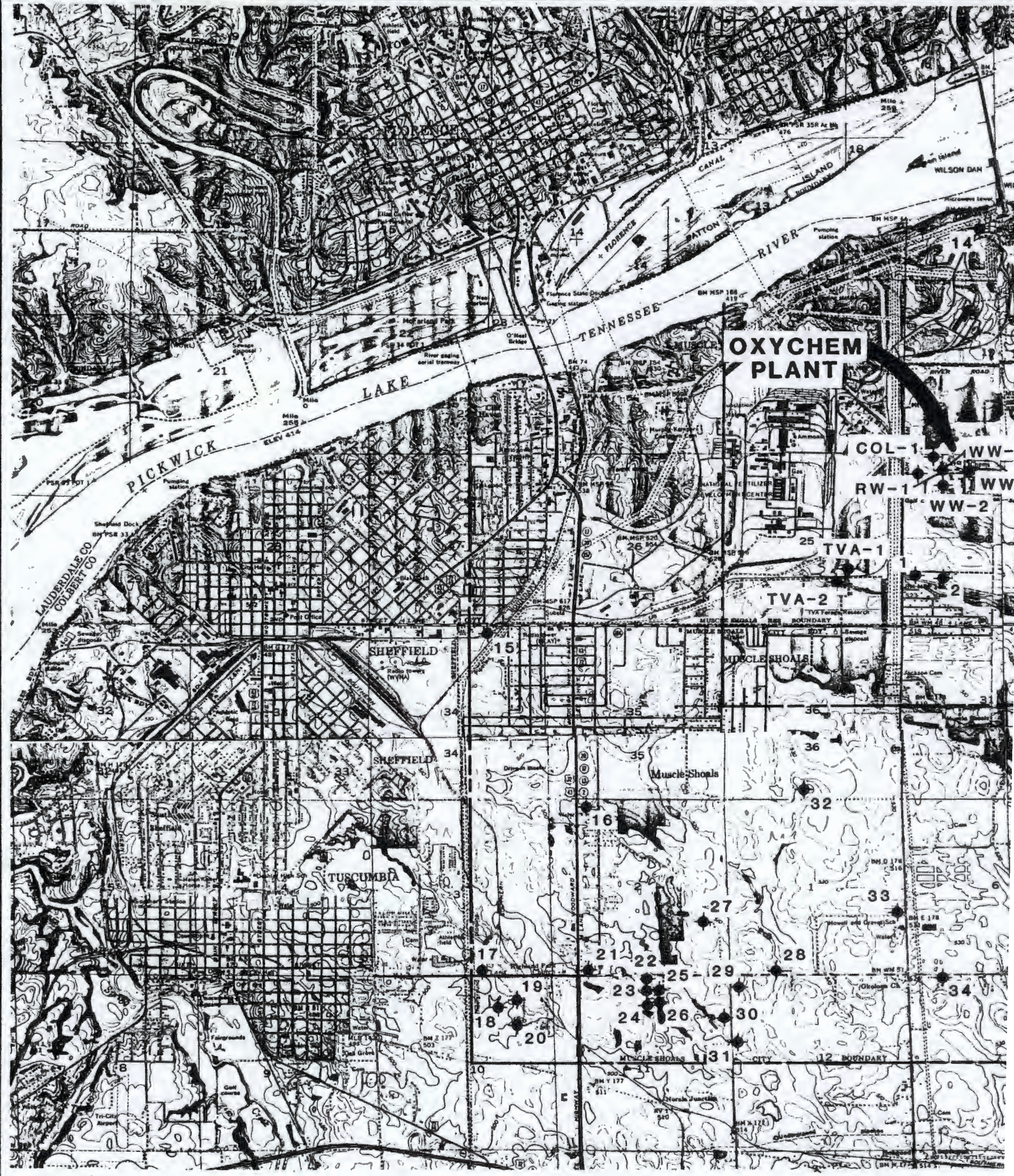
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

INDUSTRIAL SEWER AND
PLANT STORMWATER
CONTAINMENT AREA

2-4
Fig. No.



DRAWING NO. 87-0188-B38

DRAWN BY	CHECKED BY	APPROVED BY
L.M.PITRE 2-14-89		

DATE	NO.	REVISION	BY

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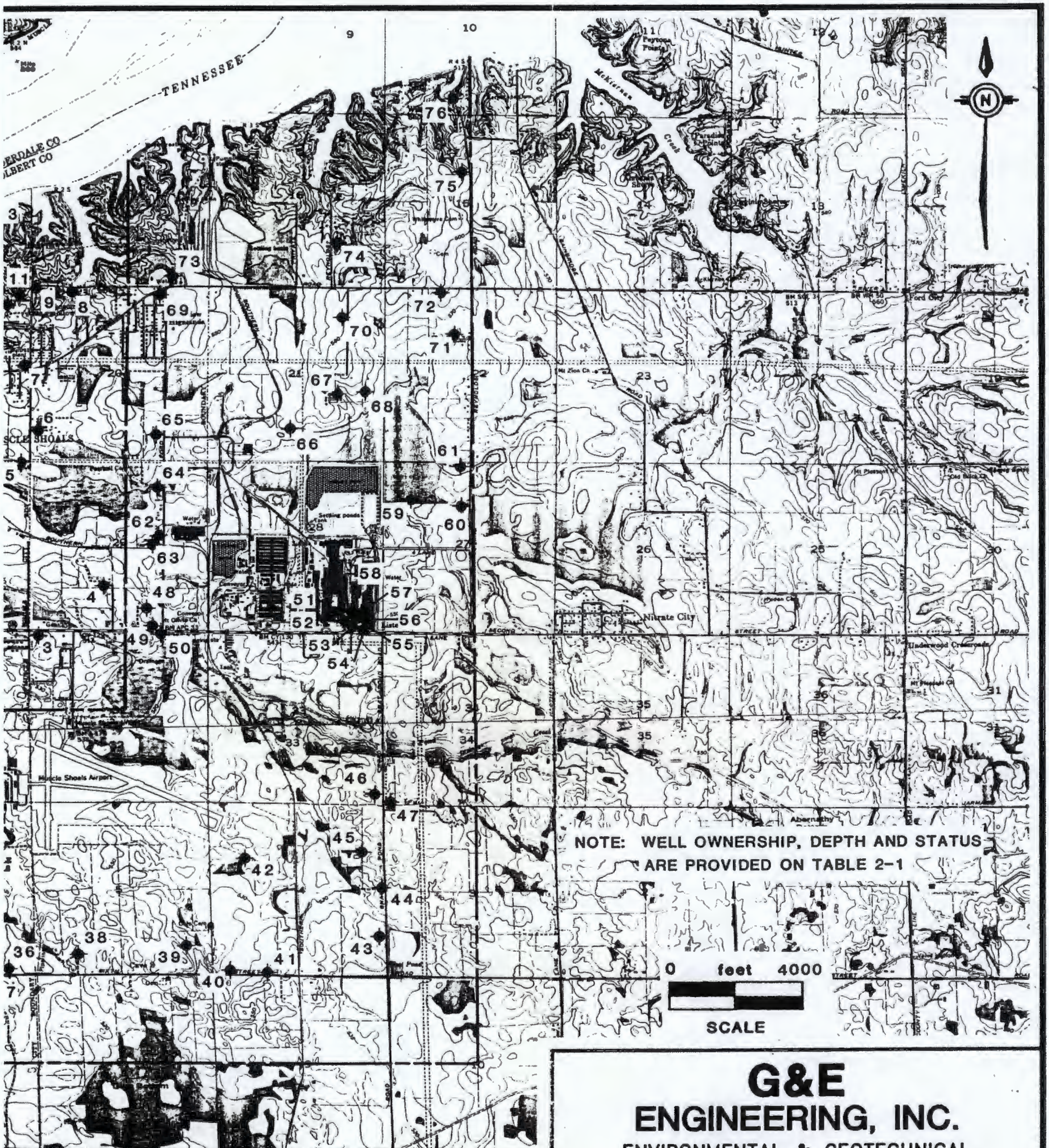
NIAGARA FALLS, NEW YORK

Client

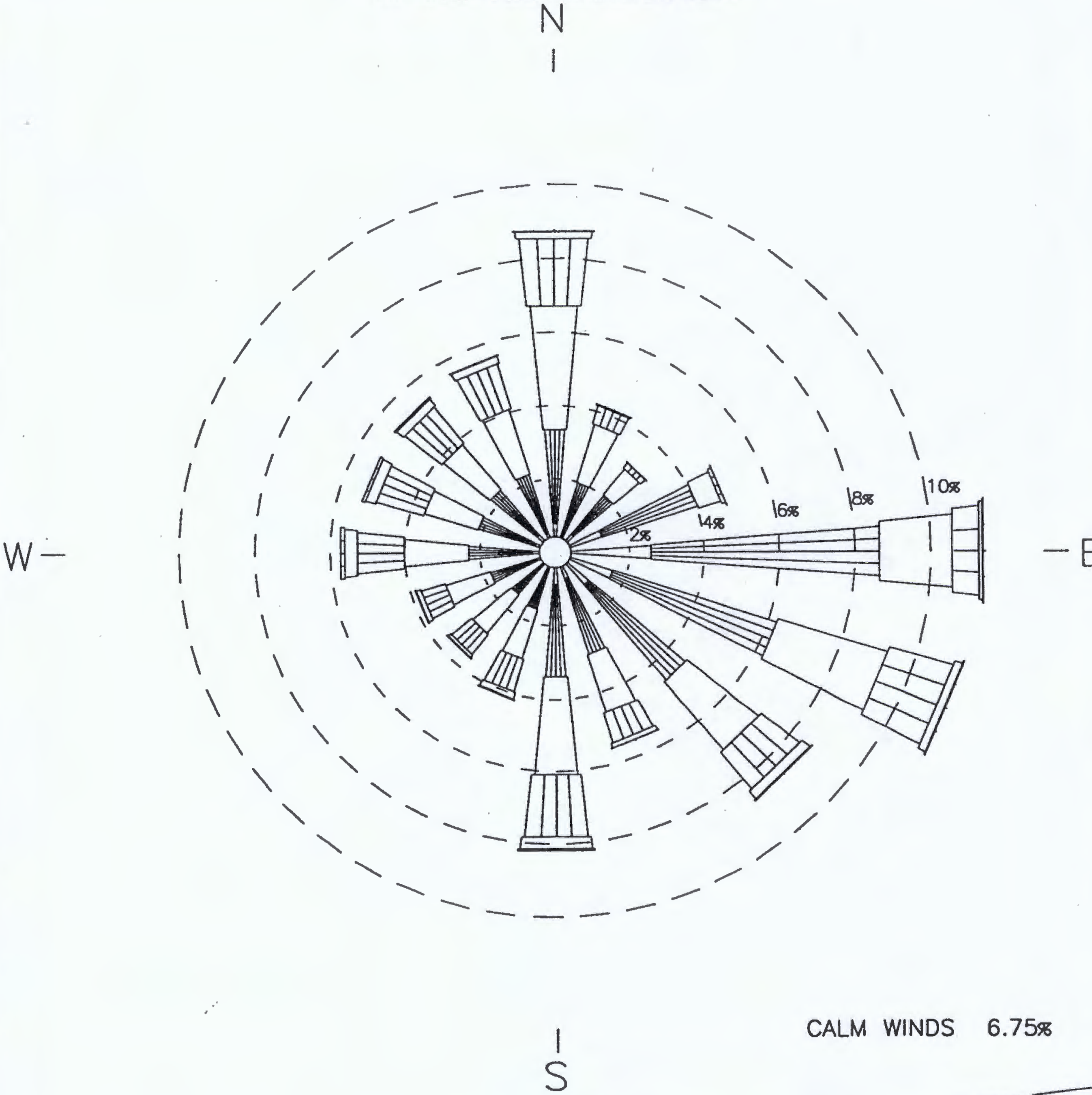
LETTERMAN'S



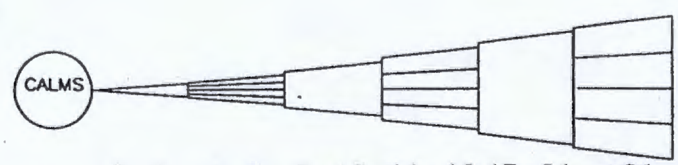
G&E
ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL
CONSULTANTS
Baton Rouge, Louisiana

OCCIDENTAL CHEMICAL **CHLOR-ALKALI FACILITY** MUSCLE SHOALS, ALABAMA Project Title	**WATER WELL MAP**	**2-5** Fig. No.

FREQUENCY OF WIND SPEED AND DIRECTION



CALM WINDS 6.75%



1–3 4–6 7–10 11–16 17–21 +21
WIND SPEED CLASS
(KNOTS)

WINDROSE
HUNTSVILLE, ALABAMA
1982–1986

ABL Drawn by	DEA Ckd. by	4–27–92 Date	0188–A180 File No.

G&E ENGINEERING, INC.
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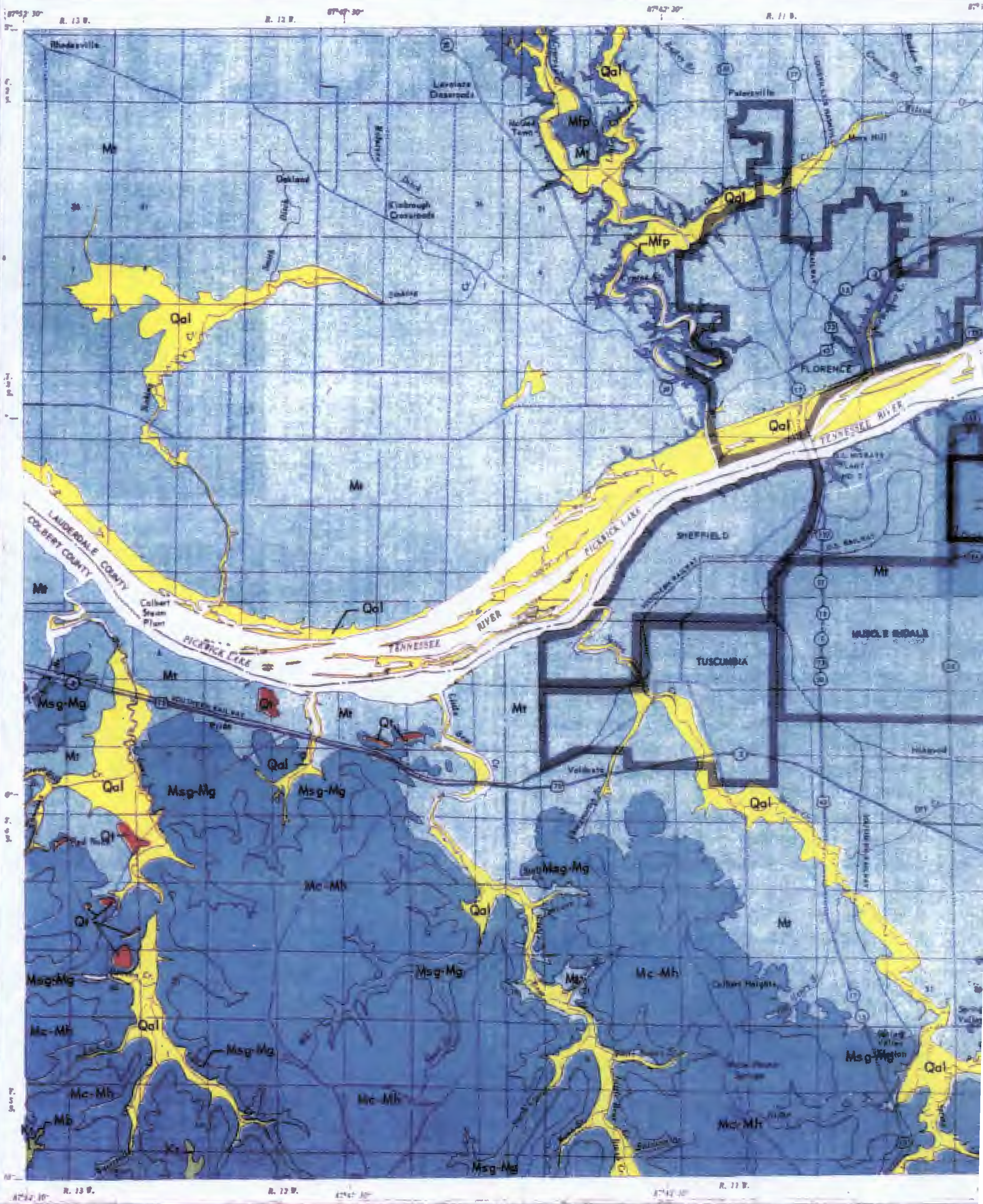
OCCIDENTAL CHEMICAL CORP.
NIAGARA FALLS, NEW YORK
Client

OCCIDENTAL CHEMICAL
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

WIND ROSE

2-6
Fig. No.



DRAWN BY	A.B. LaPRAIRIE	CHECKED BY		DRAWING NO. 87-0188-B13
	6-2-88	APPROVED BY		

DATE	NO.	REVISION	BY

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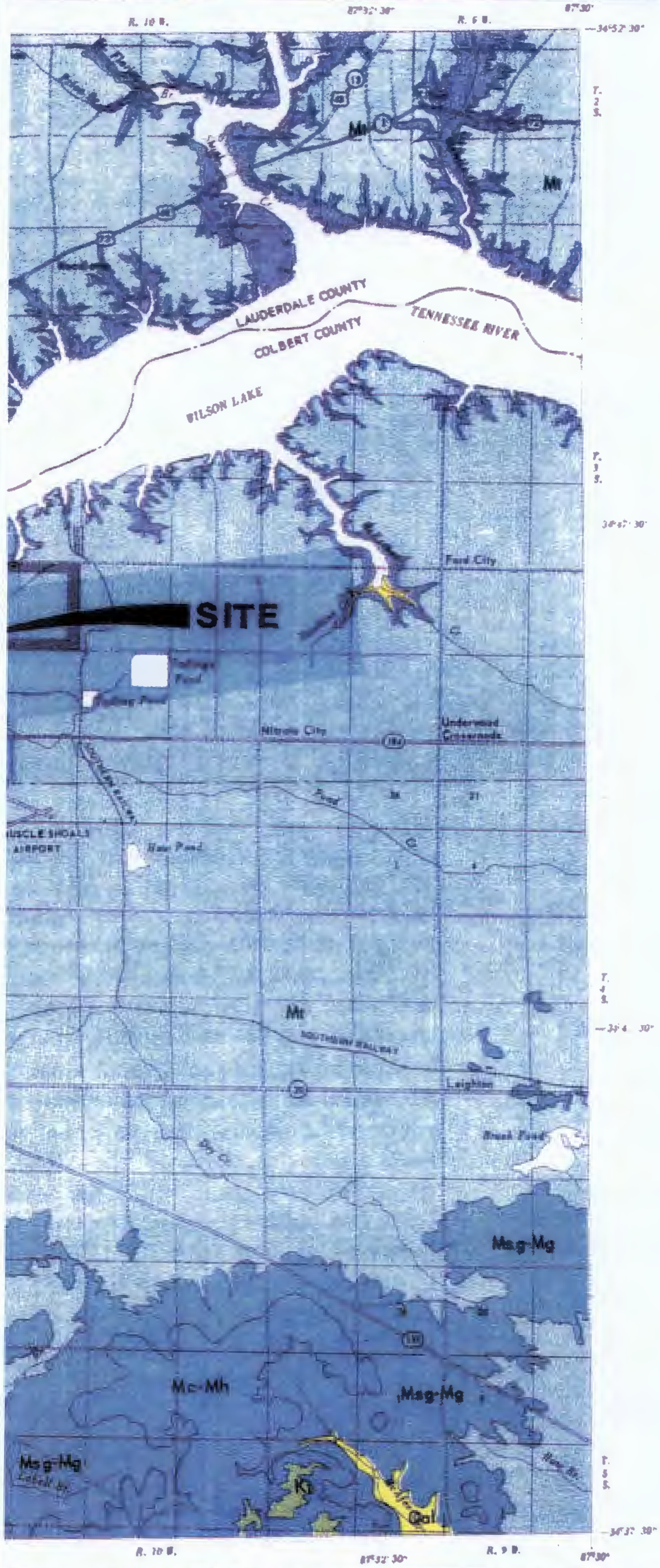
NIAGARA FALLS, NEW YORK

Client



EXPLANATION

CRETACEOUS HOLOCENE

Qal — Alluvium

Qt — Terrace

Kt — Tuscaloosa Group

MISSISSIPPIAN

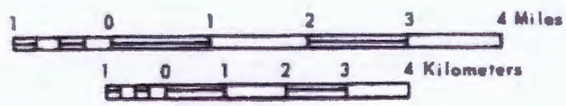
Mb — Bangor Limestone

Mc-Mh — Hartselle Sandstone, Golconda Formation, Cypress Sandstone

Msg-Mg — Gasper Formation, Bethel Sandstone, Ste. Genevieve Limestone

Mt — Tuscumbia Limestone

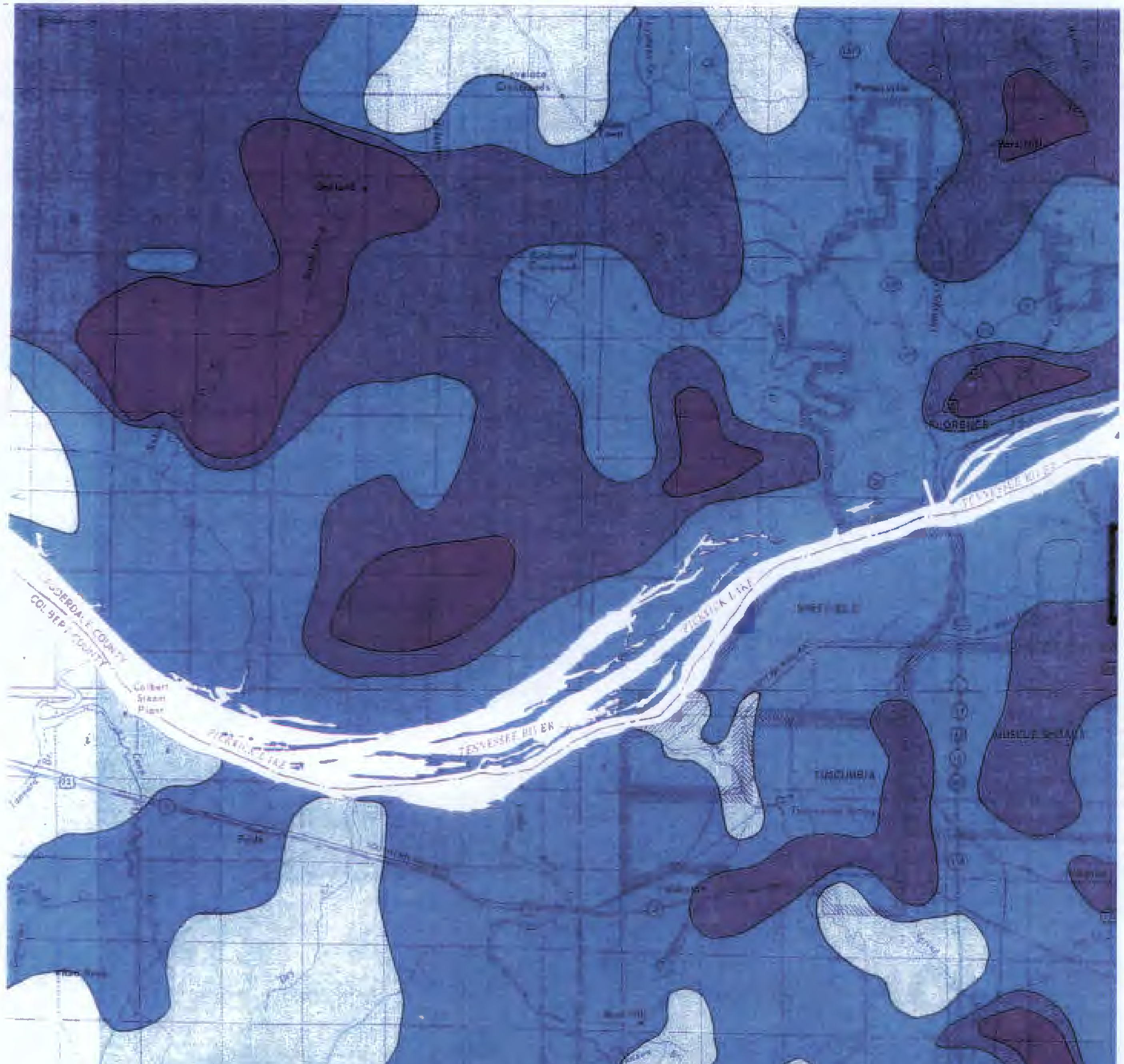
Mfp — Fort Payne Chert



RE: GEOLOGICAL SURVEY OF ALABAMA, ATLAS SERIES 6 1994, PAGE NO. 14.

G&E ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS
Baton Rouge, Louisiana

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**REGIONAL GEOLOGY**	**2-8** Fig. No.



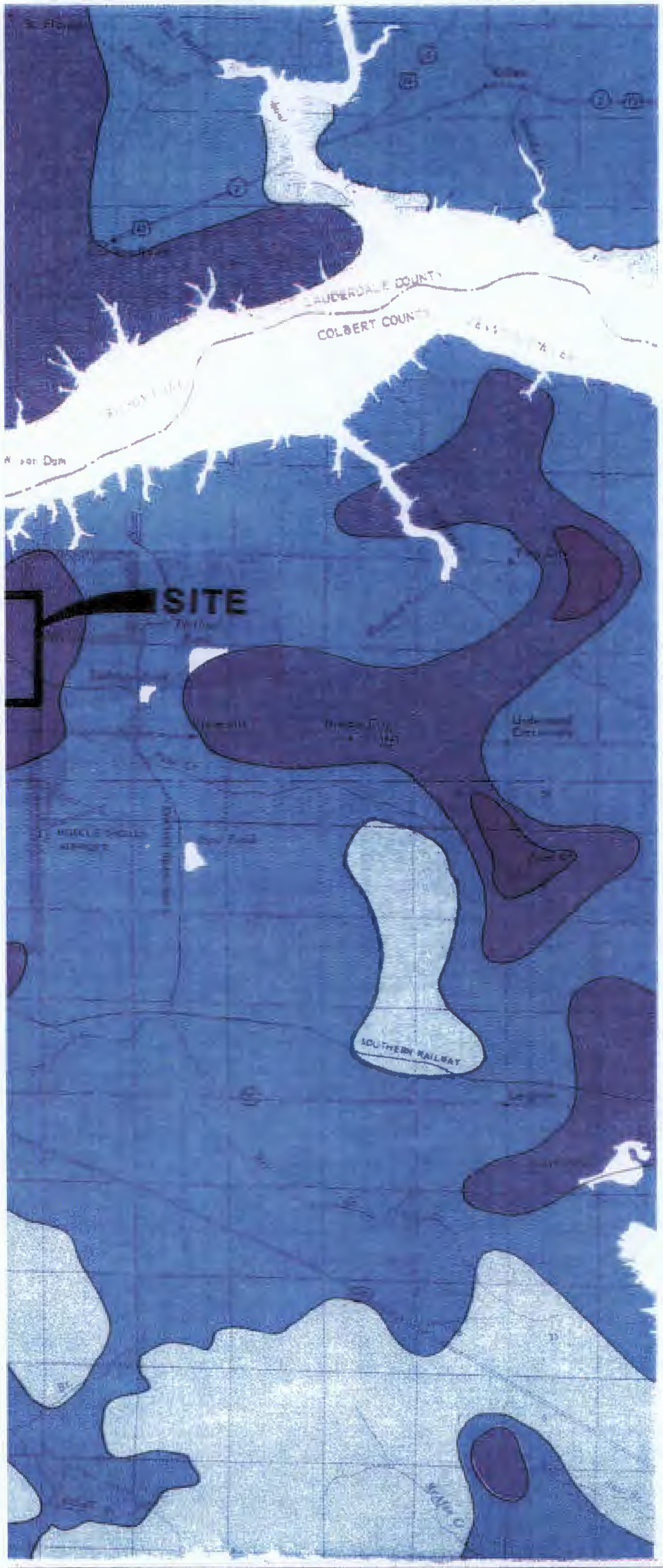
DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NO.
A.B. LaPRARIE 6-2-88			87-0188-B14

DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATIO

NIAGARA FALLS, NEW YORK

Client



Depth to Bedrock in feet

0-25

25-50

50-75

75+

Note: In a narrow band along some reaches of the Tennessee River, bedrock occurs at or near the surface. These narrow bands are not shown on this map.

1 0 1 2 3 4 Miles

1 0 1 2 3 4 Kilometers

RE: GEOLOGICAL SURVEY OF ALABAMA, ATLAS SERIES 6 1974, PAGE NO. 19.

G&E ENGINEERING, INC.

ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS

Baton Rouge, Louisiana

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY

MUSCLE SHOALS, ALABAMA

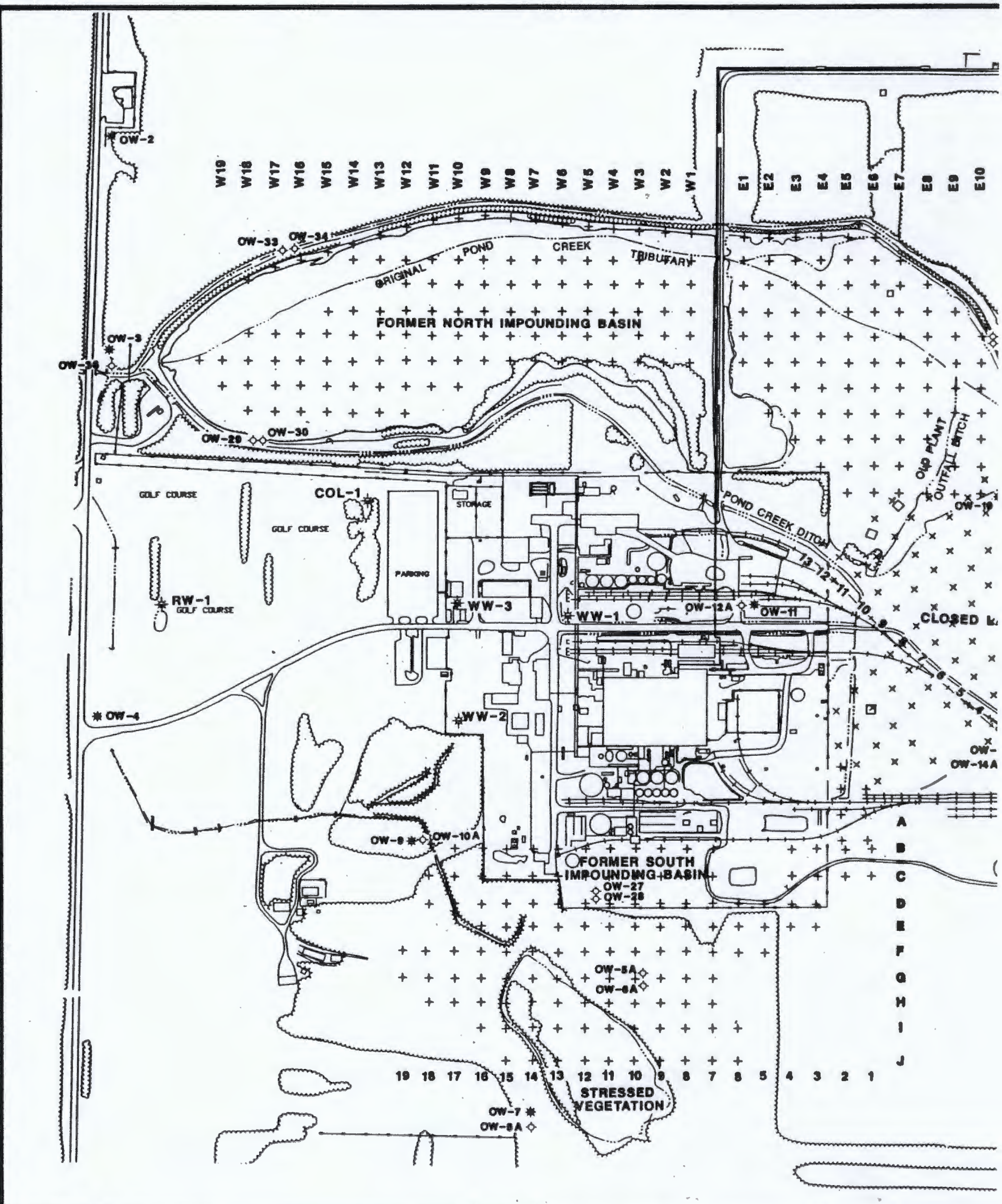
Project Title

DEPTH OF BEDROCK

2-9

Fig. No.

DRAWN BY	S.J.LeBLANC 6-2-88	CHECKED BY APPROVED BY			DRAWING NO. 87-0188-B5



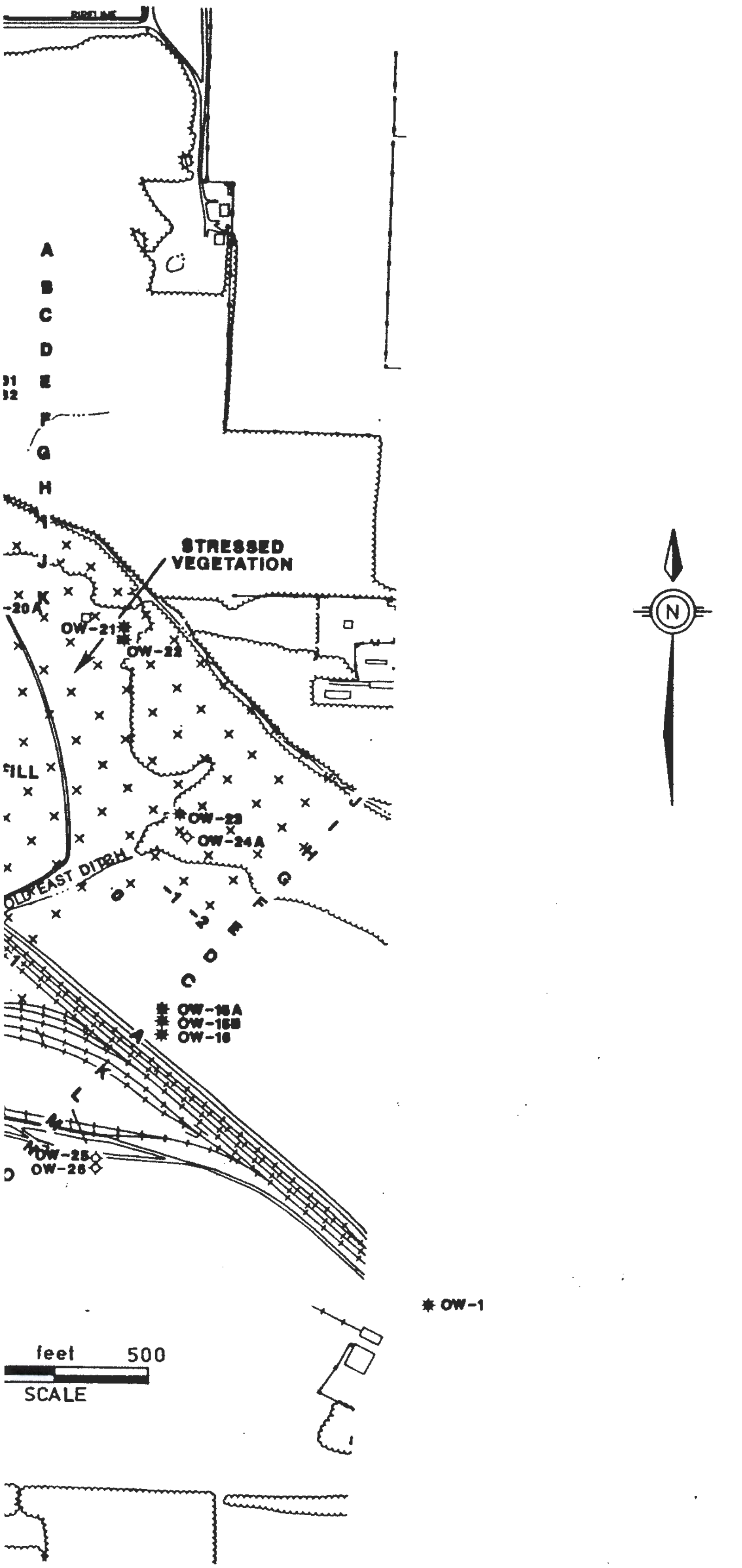
DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATI

NIAGARA FALLS, NEW YORK

Client

LETTERMANS



LEGEND

- EXISTING MONITORING WELL (UPGRADED)
- NEW MONITOR WELL
- WATER WELL

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18 & OW-35 NOT USED.

G&E ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS
Baton Rouge, Louisiana

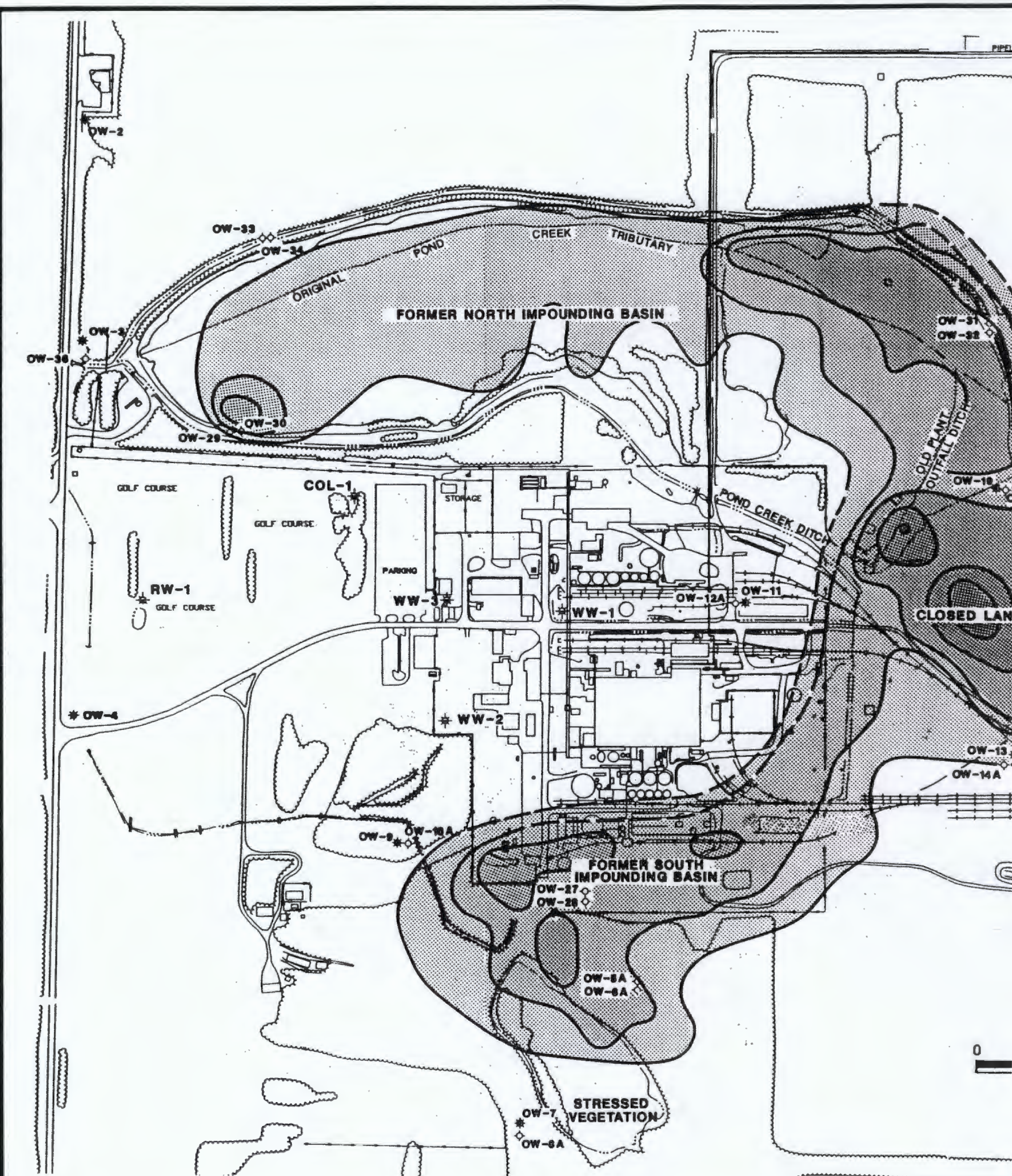
OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**GEOPHYSICAL SURVEY GRID SYSTEM**	**3-1** Fig. No.

DRAWN BY L.M. PITRE 4-27-92

CHECKED BY [illegible] 6/25/92

APPROVED BY [illegible] 6/25/92

DRAWING NO. 87-0188-B6

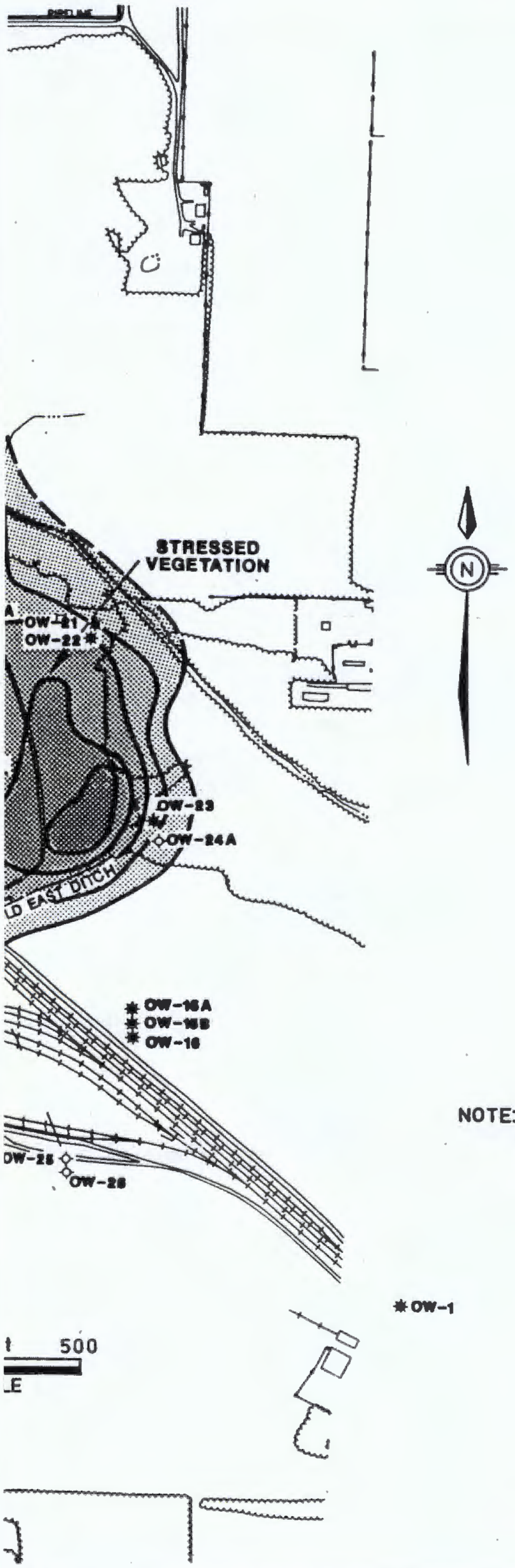


DATE	NO.	REVISION	BY

OCCIDENTIAL CHEMICAL CORPORATI

NIAGARA FALLS, NEW YORK

Client



LEGEND

20 TO 60 mmhos/m CONDUCTIVITY

60 TO 100 mmhos/m CONDUCTIVITY

100 TO 200 mmhos/m CONDUCTIVITY

200 TO 300 mmhos/m CONDUCTIVITY

300+ mmhos/m CONDUCTIVITY

EXISTING MONITORING WELL (UPGRADED)

NEW MONITOR WELL

WATER WELL

NOTE: OW–2, OW–4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW–17, OW–18, & OW–35 NOT USED.

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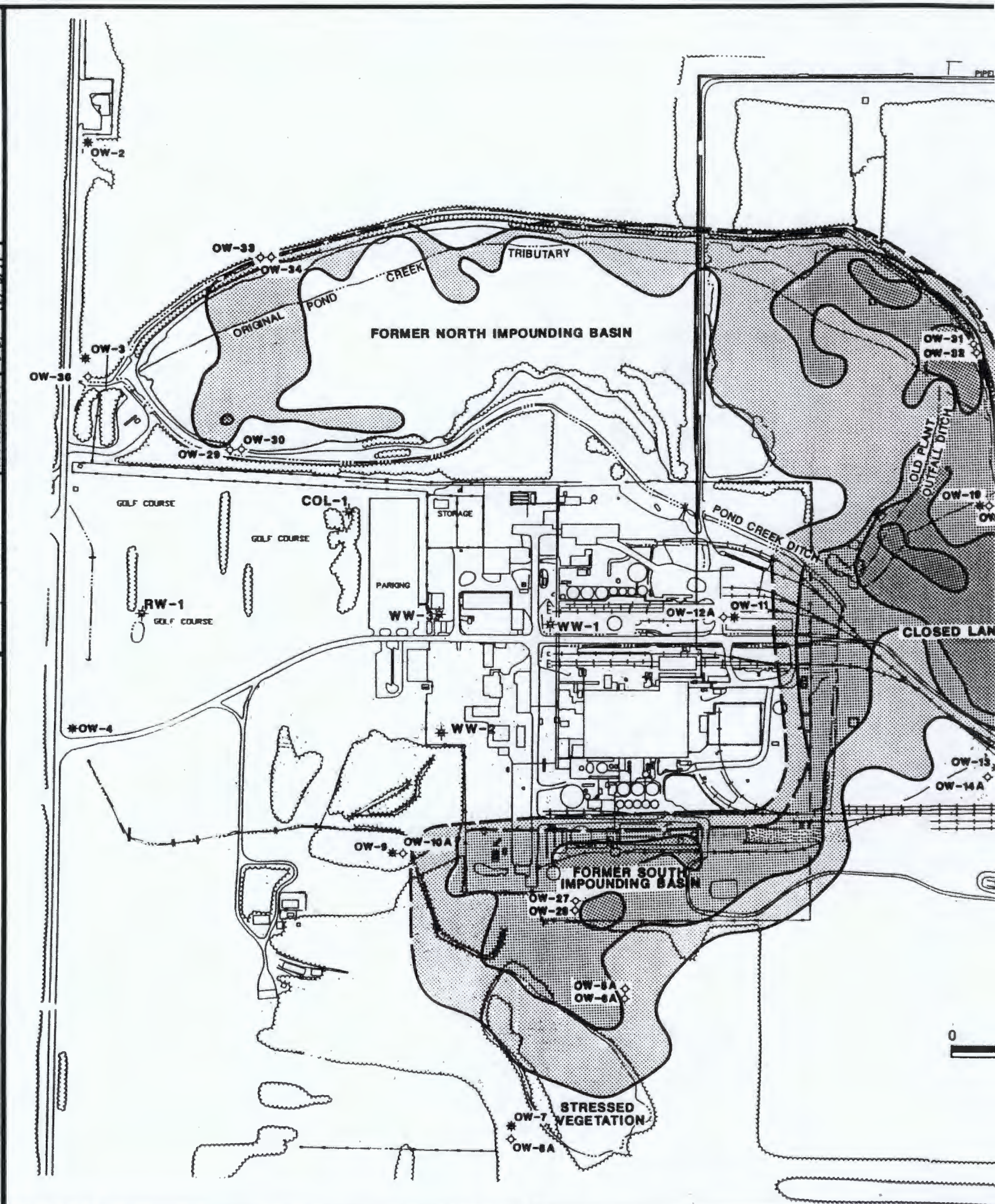
OCCIDENTIAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**GEOPHYSICAL SURVEY CONTOURS EM-31 6m DEPTH**	**3-2** Fig. No.



DRAWN BY	L.M. PITRE 4-23-92	CHECKED BY APPROVED BY	6/25/92 6/25/92	DRAWING NO.	87-0188-B7

DATE	NO.	REVISION	BY

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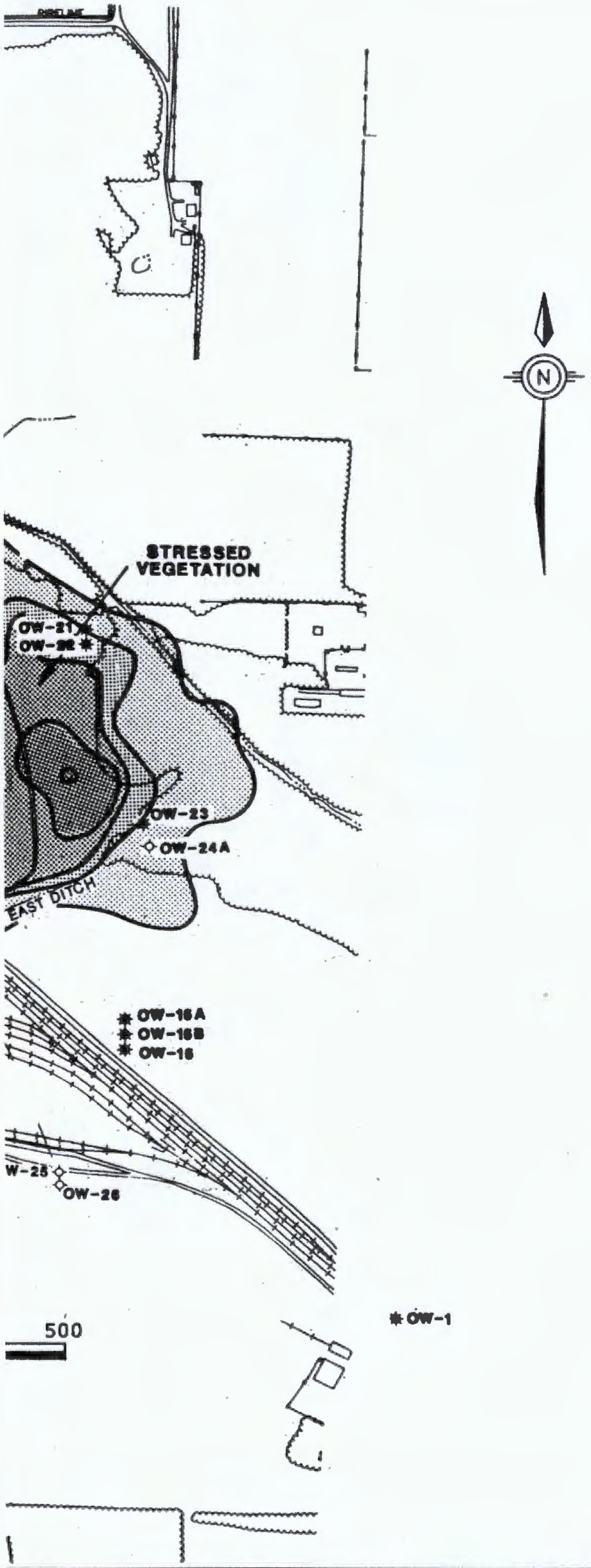
NIAGARA FALLS, NEW YORK
Client



LEGEND

- 20 TO 60 mmhos/m CONDUCTIVITY
- 60 TO 100 mmhos/m CONDUCTIVITY
- 100 TO 200 mmhos/m CONDUCTIVITY
- 200 TO 300 mmhos/m CONDUCTIVITY
- 300+ mmhos/m CONDUCTIVITY
- EXISTING MONITORING WELL (UPGRADED)
- NEW MONITOR WELL
- WATER WELL

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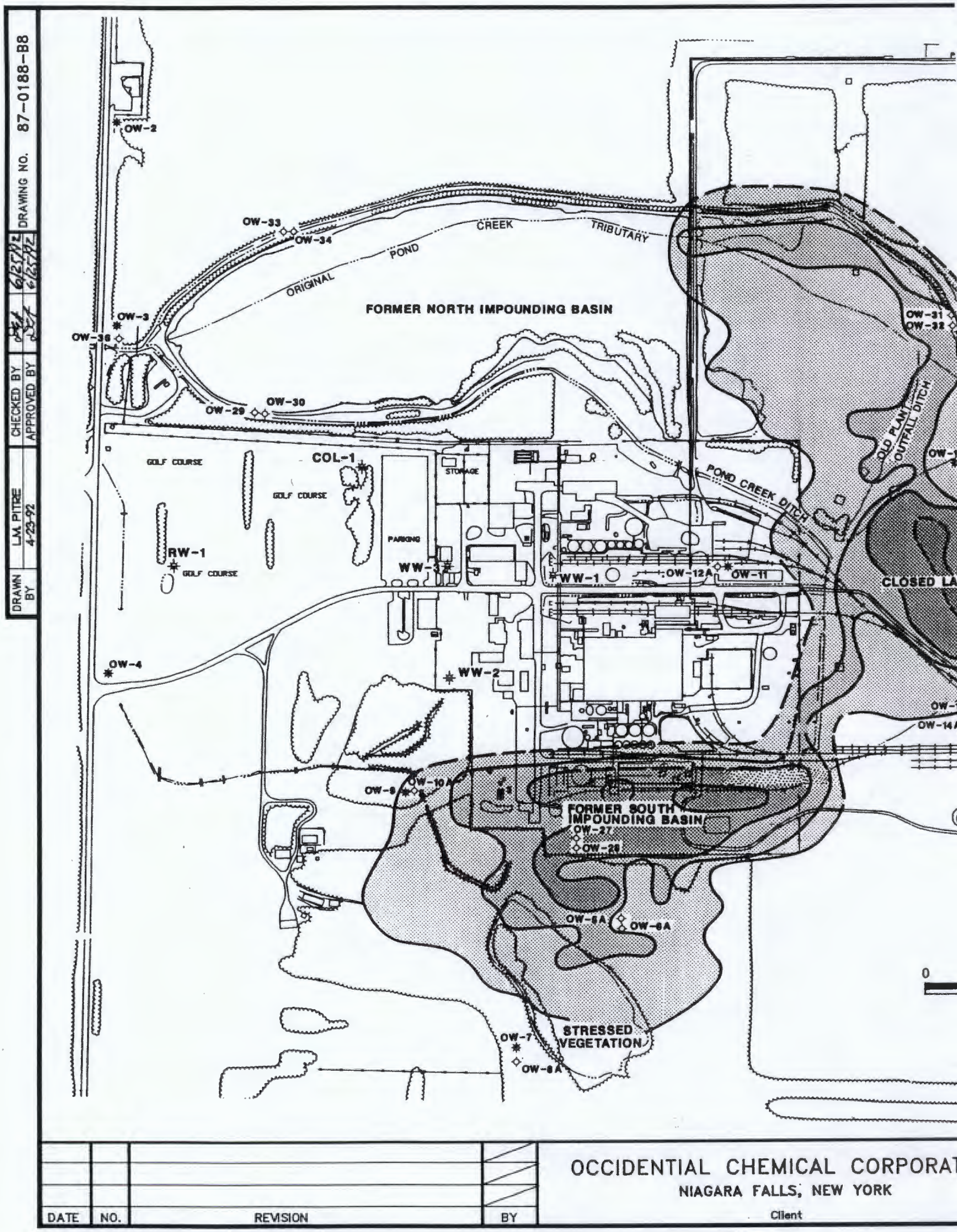
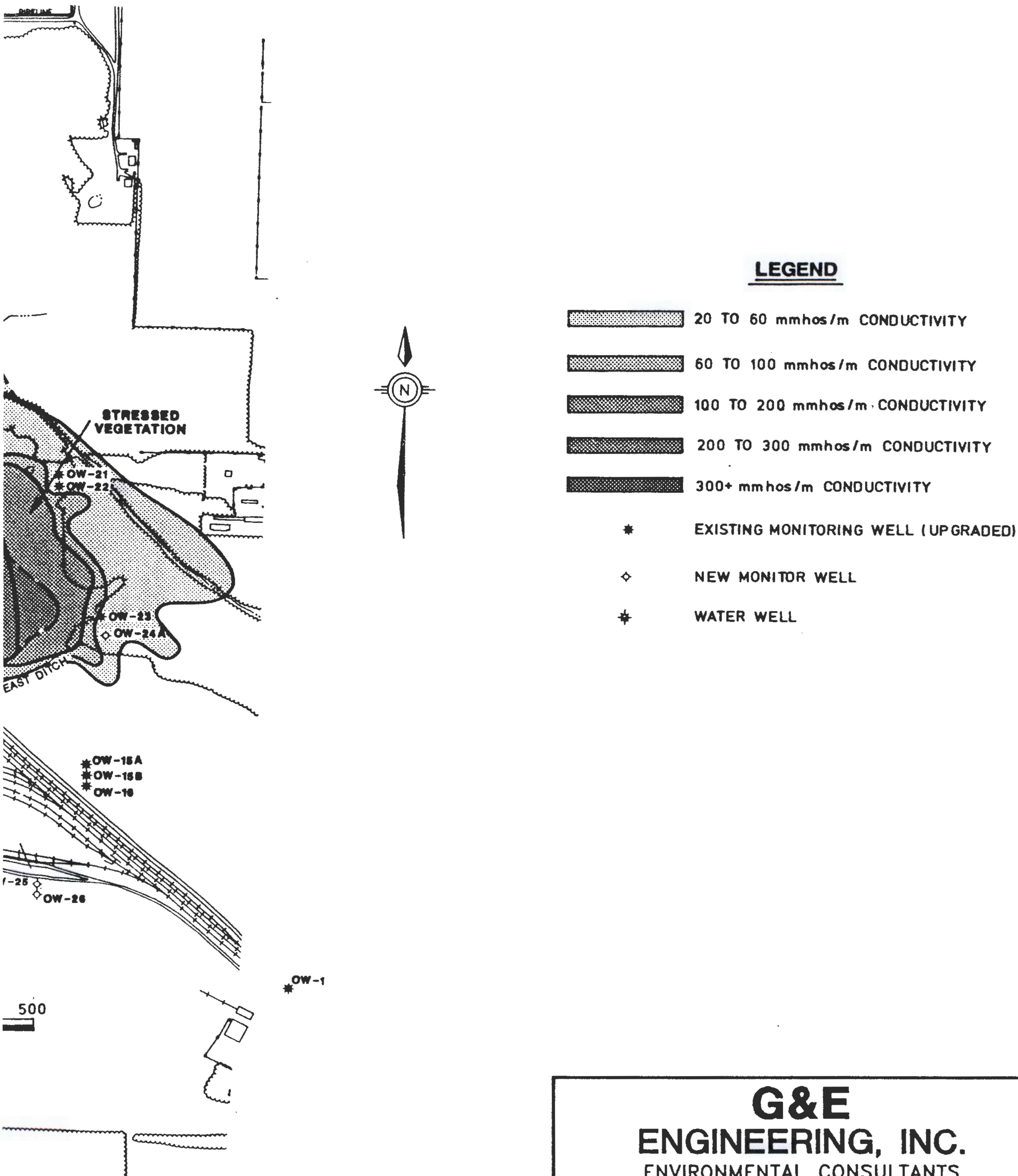
OCCIDENTIAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**GEOPHYSICAL SURVEY CONTOURS EM-34 10m DEPTH**	**3-3** Fig. No.


DRAWN BY L.M. PITRE 4-23-92
CHECKED BY
APPROVED BY
DRAWING NO. 87-0188-B8
OW-2
OW-33
OW-34
CREEK
TRIBUTARY
POND
ORIGINAL
FORMER NORTH IMPOUNDING BASIN
OW-3
OW-36
OW-29
OW-30
OW-31
OW-32
OLD PLANT OUTFALL DITCH
GOLF COURSE
COL-1
STORAGE
POND CREEK DITCH
PARKING
RW-1
WW-3
WW-1
OW-12A
OW-11
CLOSED LA
OW-4
WW-2
OW-14A
OW-9
OW-10A
FORMER SOUTH IMPOUNDING BASIN
OW-27
OW-28
OW-5A
OW-6A
STRESSED VEGETATION
OW-7
OW-8A
0
DATE
NO.
REVISION
BY
OCCIDENTIAL CHEMICAL CORPORAT
NIAGARA FALLS, NEW YORK
Client



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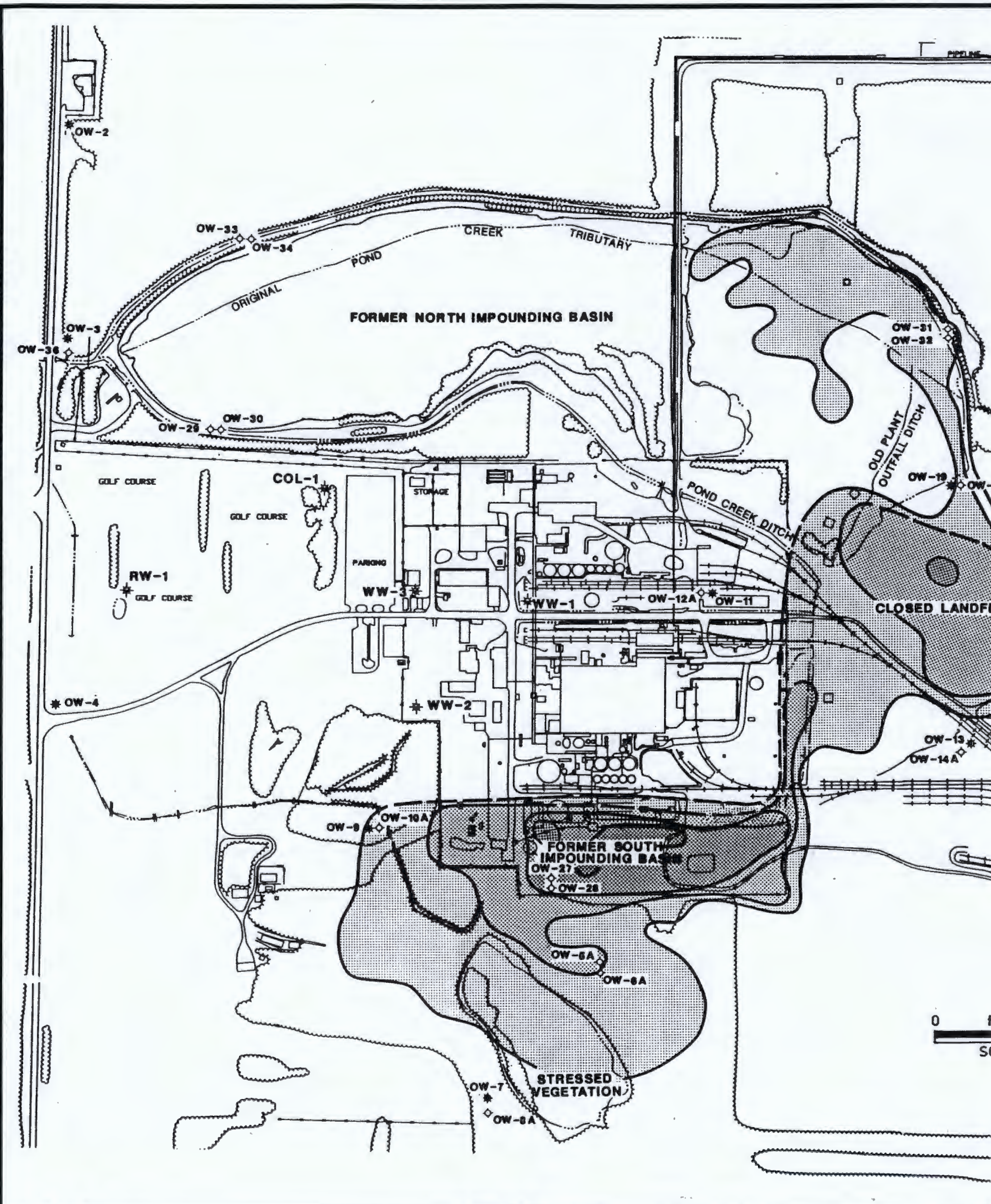
ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTIAL CHEMICAL
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

GEOPHYSICAL SURVEY
CONTOURS EM-34
20m DEPTH

3-4
Fig. No.

DRAWN BY	LM PITRE	4-23-92	CHECKED BY	APPROVED BY	6/25/92	6/25/92	DRAWING NO.	87-0188-B9

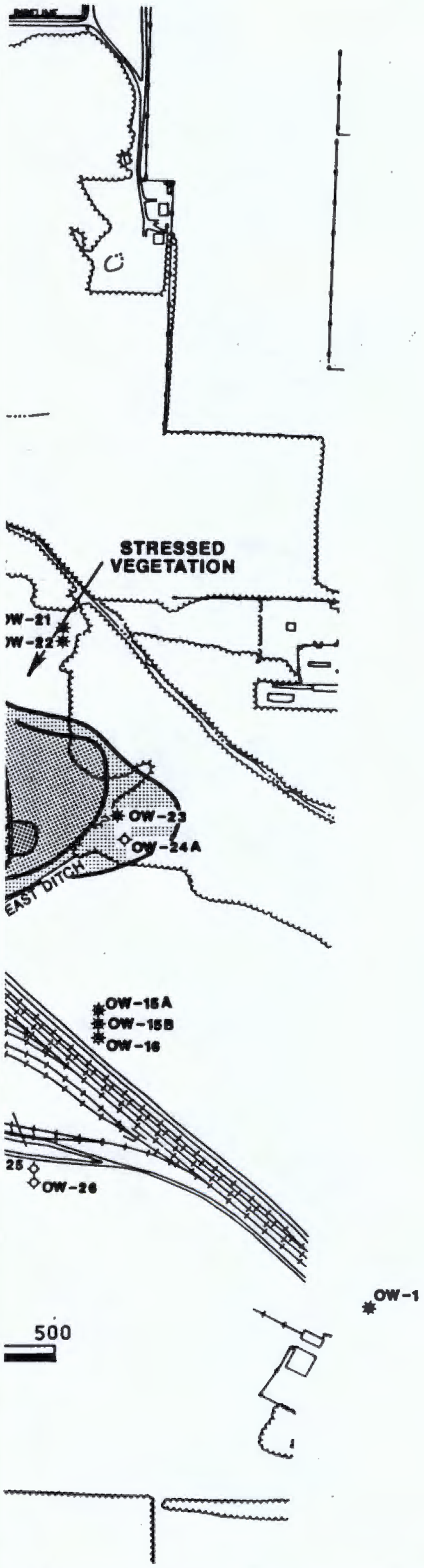


DATE	NO.	REVISION	BY

OCCIDENTIAL CHEMICAL CORPORATI

NIAGARA FALLS, NEW YORK

Client



LEGEND

20 TO 60 mmhos/m CONDUCTIVITY

60 TO 100 mmhos/m CONDUCTIVITY

100 TO 200 mmhos/m CONDUCTIVITY

200 TO 300 mmhos/m CONDUCTIVITY

EXISTING MONITORING WELL (UPGRADED)

NEW MONITOR WELL

WATER WELL

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS.
EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS.
WELL NOS. OW-17, OW-18, & OW-35 NOT USED.

G&E ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

Project Title		Fig. No.
OCCIDENTIAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA	**GEOPHYSICAL SURVEY CONTOURS EM-34 40m DEPTH**	**3-5**

DRAWN BY L.M.PITRE 6-22-92
CHECKED BY 6/25/92
APPROVED BY 6/25/92
DRAWING NO. 87-0188-B161
FORMER NORTH IMPOUNDING BASIN
B-11
B-18
B-12
B-10
B-9
COL-1
STORAGE
GOLF COURSE
PARKING
B-7
CLOSED LANDFILL
B-17
B-8
B-35
B-36
RW-1
GOLF COURSE
WW-3
WW-1
B-21
WW-2
B-24
B-38
B-39
OLD EAST DITCH
B-5
B-19
B-25
B-20
B-27
B-26
B-41
B-28
B-37
B-40
B-42
B-29
FORMER WASTE PILE B
B-14
B-3
FORMER SOUTH IMPOUNDING BASIN
B-31
B-30
B-13
B-16
B-4
B-15
B-2
STRESSED VEGETATION
B-1
B-33
B-34
DATE
NO.
REVISION
BY
OCCIDENTAL CHEMICAL CORPORATIO
NIAGARA FALLS, NEW YORK
Client

LEGEND

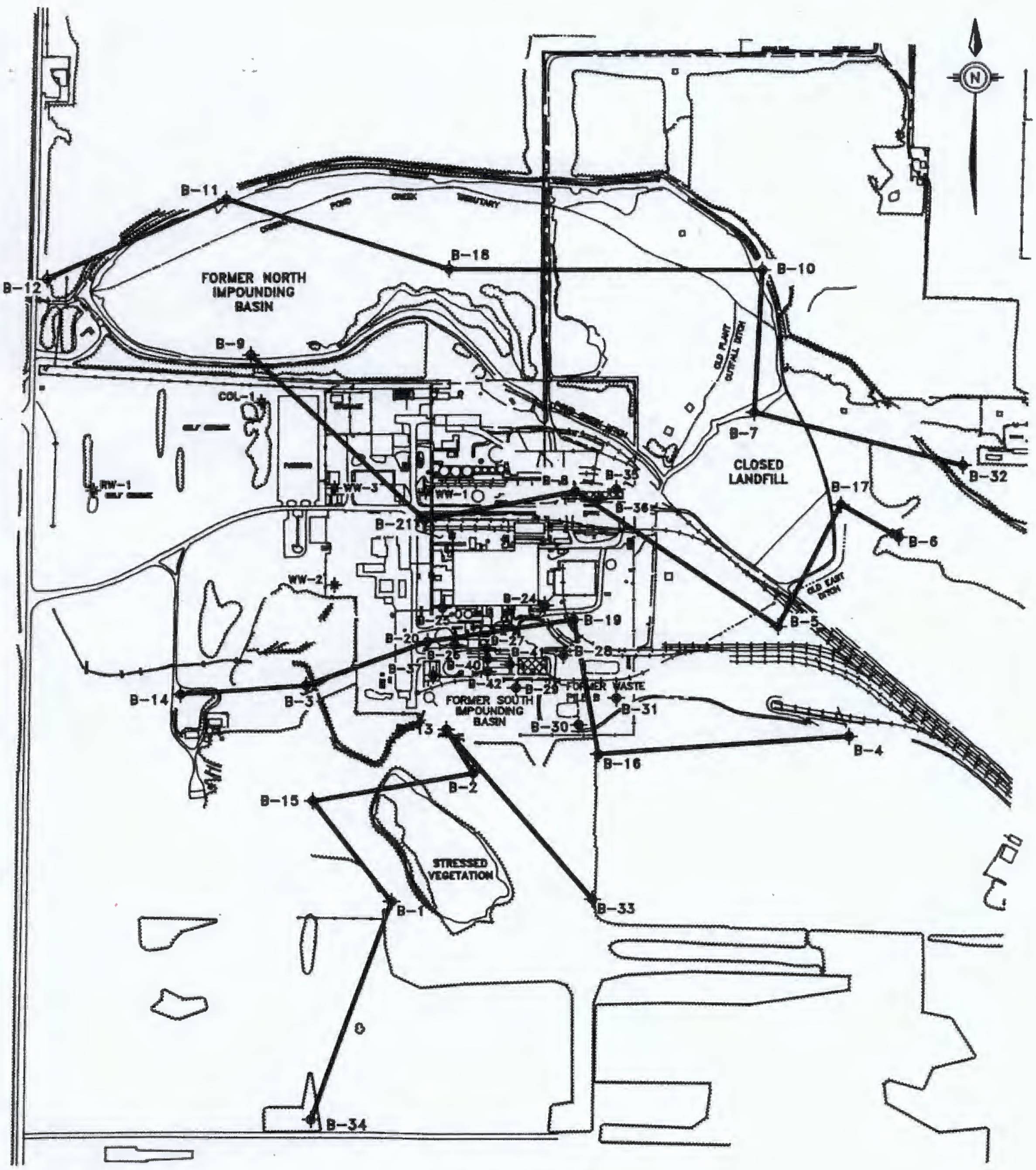
✦ SOIL BORING LOCATION

0 feet 600
SCALE

G&E
ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**BORING LOCATIONS**	**3-6** Fig. No.

DRAWN BY	L.M.PITRE	5-18-92
CHECKED BY		
APPROVED BY		
DRAWING NO.	87-0188-B160	



PLAN VIEW

0 feet 800
SCALE

LEGEND

✦ SOIL BORING LOCATION

B-12
(OW-36)

Depth (ft)	Hg (mg/kg)
0 - 2	0.07
3 - 5	0.07
8 - 10	0.02
13 - 15	<0.02
18 - 20	<0.02
23 - 25	0.07
28 - 30	<0.02
33 - 35	0.04
38 - 40	0.05
43 - 45	0.03
48 - 50	0.02
53 - 55	0.02
58 - 60	0.05

B-9
(OW-30)

Depth (ft)	Hg (mg/kg)
0 - 2	0.06
3 - 5	0.05
8 - 10	0.02
13 - 15	0.03
18 - 20	0.02
23 - 25	0.02
28 - 30	0.02
33 - 35	0.06
38 - 40	0.05

B-14
(OW-38)

Depth (ft)	Hg (mg/kg)
0 - 2	0.66
3 - 5	0.05
8 - 10	0.02
13 - 15	<0.02
18 - 20	<0.02
23 - 25	0.03
28 - 30	0.03
33 - 35	0.03
38 - 40	0.04
43 - 45	0.03
48 - 50	0.02
53 - 55	0.02
58 - 60	<0.02
63 - 65	0.05

B-34
(OW-56)

Depth (ft)	Hg (mg/kg)
0 - 2	0.03
3 - 5	0.05
8 - 10	0.07
13 - 15	0.04
18 - 20	0.03
23 - 25	0.08
28 - 30	0.07
33 - 35	0.05
48 - 50	0.05
58 - 60	0.02
63 - 65	0.03
67 - 69	0.13

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...g/kg)
10
70
55
30
55
10
10
10
10
10
10
10
10

B-11 (OW-34)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.03	135
3 - 5	0.02	55
8 - 10	<0.02	390
13 - 15	<0.02	280
18 - 20	<0.02	335
23 - 25	<0.02	45
28 - 30	<0.02	60
33 - 35	<0.02	270
38 - 40	0.03	205
43 - 45	0.06	115
48 - 49	<0.02	115

B-18 (OW-44)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.91	50
3 - 5	39.0	25
8 - 10	0.25	90
13 - 15	0.11	10
18 - 20	0.12	<10
23 - 25	0.05	<10
28 - 30	0.09	<10
33 - 35	0.59	<10
38.5 - 40	0.28	<10

B-10 (OW-32)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	67.0	70
3 - 5	5.3	60
8 - 10	0.03	81
13 - 15	<0.02	675
18 - 20	<0.02	170
23 - 25	<0.02	145
28 - 30	0.02	295
33 - 35	0.07	215
38 - 40	0.05	100
43.5 - 45	0.04	150
48 - 50	0.06	100
58 - 60	0.02	255
63 - 65	0.03	170
68 - 70	0.04	85

B-7 (OW-20A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.03	<10
3 - 5	<0.02	950
8 - 10	0.02	495
13 - 15	0.05	320
18 - 20	0.02	90
23 - 25	0.03	45
28 - 30	<0.02	55
33 - 35	0.13	70
38 - 40	0.02	50
43 - 45	0.02	65
48 - 50	0.02	55
62 - 63.5	0.02	15
73 - 75	0.09	70
78 - 80	0.03	40
83 - 85	0.02	35

B-32 (OW-52)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 3	0.06	<10
3 - 5	0.02	25
8 - 10	0.05	25
13 - 15	0.09	10
18 - 20	0.03	<10
23 - 25	0.11	<10
28 - 30	0.04	<10
33 - 35	0.06	<10
38 - 40	0.48	<10
43 - 45	0.17	<10
48 - 50	0.10	<10
53 - 55	0.10	<10
62 - 67	0.10	<10

...g/kg)
90
20
20
10
75
50
75
50
70

B-21 (OW-50)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	21.0	<10
3 - 5	0.14	<10
8 - 10	0.03	<10
13 - 15	0.04	<10
18 - 20	0.03	110
23 - 25	0.03	330
28 - 30	0.06	200
33 - 35	0.05	85
38 - 40	0.03	<10
43 - 45	0.09	<10
53 - 55	0.09	555

B-8 (OW-12A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.16	40
3 - 5	0.18	40
8 - 10	0.15	20
13 - 15	0.13	20
18 - 20	0.12	15
23 - 25	0.15	50
52 - 58	0.15	185

B-5 (OW-14A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.033	<10
3 - 5	<0.02	50
8 - 10	0.07	80
13 - 15	<0.02	115
18 - 20	<0.02	205
23 - 25	<0.02	90
28 - 30	<0.02	<10
33 - 35	<0.02	<10
38 - 40	<0.02	<10
43 - 45	<0.02	100
48 - 50	0.02	215
53 - 55	0.05	290

B-17 (OW-43)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.57	9,000
3 - 5	0.08	11,500
8 - 10	0.05	350
13 - 15	0.05	<10
18 - 20	0.05	<10
23 - 25	0.08	<10
28 - 30	0.06	<10
33 - 35	0.07	30
38 - 40	0.08	340
43 - 45	0.09	110
48 - 50	0.11	110
53 - 55	0.12	175
58 - 60	0.08	215
63 - 65	0.08	1,120

B-6 (OW-24A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.04	525
3 - 5	0.04	765
8 - 10	0.02	35
13 - 15	0.05	10
18 - 20	0.05	50
23 - 25	0.04	40
28 - 30	0.02	<10
33 - 35	0.02	125
38 - 40	0.02	<10
43 - 45	<0.02	175
53 - 55	0.24	<10
53 - 65	0.02	<10

...g/kg)
40
10
60
55
55
45
10
10
10
10
10
10
12
35

B-3 (OW-10A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	<0.02	415
3 - 5	<0.02	640
8 - 10	<0.02	315
13 - 15	<0.02	430
18 - 20	0.02	1,450
23 - 25	0.05	1,000
28 - 30	0.05	180
33 - 35	0.02	265
38 - 40	<0.02	1,200
46 - 48	<0.02	800

B-20 (OW-48)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	1.0	4,400
3 - 5	0.35	2,050
8 - 10	0.08	6,850
13 - 15	0.03	7,000
18 - 20	0.02	16,200
23 - 25	0.05	10,200
28 - 30	0.13	4,300
33 - 35	0.10	3,550

B-19 (OW-46)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	33.0	100
3 - 5	0.72	120
8 - 10	0.61	2,000
13 - 15	0.46	13,000
15 - 16.5	0.06	20,200
22 - 24	0.14	28,500
33 - 35	0.13	495
38 - 40	0.11	1,985
43 - 45	0.24	3,280
46 - 49	0.05	6,750

B-16 (OW-41)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.07	10
3 - 5	0.05	30
8 - 10	0.04	15
13 - 15	0.04	<10
18 - 20	<0.02	15
23 - 25	0.07	10
28 - 30	0.04	<10
33 - 35	0.02	15
38 - 40	0.04	10
43 - 45	0.06	10
48 - 50	0.02	270

B-4 (OW-26)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.04	20
3 - 5	0.04	70
8 - 10	0.06	65
13 - 15	0.05	<10
18 - 20	0.05	50
23 - 25	0.05	<10
28 - 30	0.07	<10
33 - 35	0.05	40
38 - 40	0.05	95
43 - 45	0.03	35
48 - 50	0.13	60

...g/kg)
15
40
10
10
10
10
10
10
10
20
40
10

B-1 (OW-8A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.02	15
3 - 5	<0.02	135
8 - 10	0.02	180
13 - 15	0.07	115
18 - 20	0.02	140
23 - 25	<0.02	130
28 - 30	<0.02	5
33 - 35	<0.02	5
38 - 40	0.49	30
43 - 45	0.05	<1.0
48 - 50	0.02	10
53.5 - 55	0.03	<1.0
58 - 60	<0.02	<1.0
63 - 65	0.05	5
69 - 70.5	0.02	30

B-15 (OW-40)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.10	15
3 - 5	0.04	70
8 - 10	0.08	80
13 - 15	0.07	105
18 - 20	<0.02	35
23 - 25	0.10	135
28 - 30	0.07	30
33 - 35	0.05	<10
38 - 40	0.08	35
43 - 45	0.12	<100

B-2 (OW-[illegible]A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.09	75
3 - 5	0.11	150
8 - 10	1.3	515
13 - 15	0.07	1,150
18 - 20	0.02	3,350
23 - 25	0.33	2,500
28.5 - 30	0.07	680
33.5 - 35	0.06	655
38 - 40	0.26	375
43 - 45	0.04	915
48 - 50	0.10	2,850

B-13 (OW-28)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.16	25
3 - 5	64.0	125
8 - 10	12.0	175
13 - 15	3.3	500
18 - 20	<0.02	3,000
23 - 25	<0.02	4,000
28 - 30	0.05	4,750
33.5 - 35	0.02	565
38 - 40	0.05	<10
43 - 45	<0.02	900
48.5 - 50	0.14	800
53 - 55	0.02	785

B-33 (OW-54)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.04	<10
3 - 5	0.03	<10
8 - 10	0.03	<10
13 - 15	0.08	40
18 - 20	0.06	30
23 - 25	0.02	10
30 - 33	0.08	20
34 - 38	0.05	125
43 - 45	0.06	<10
48 - 50	0.03	75

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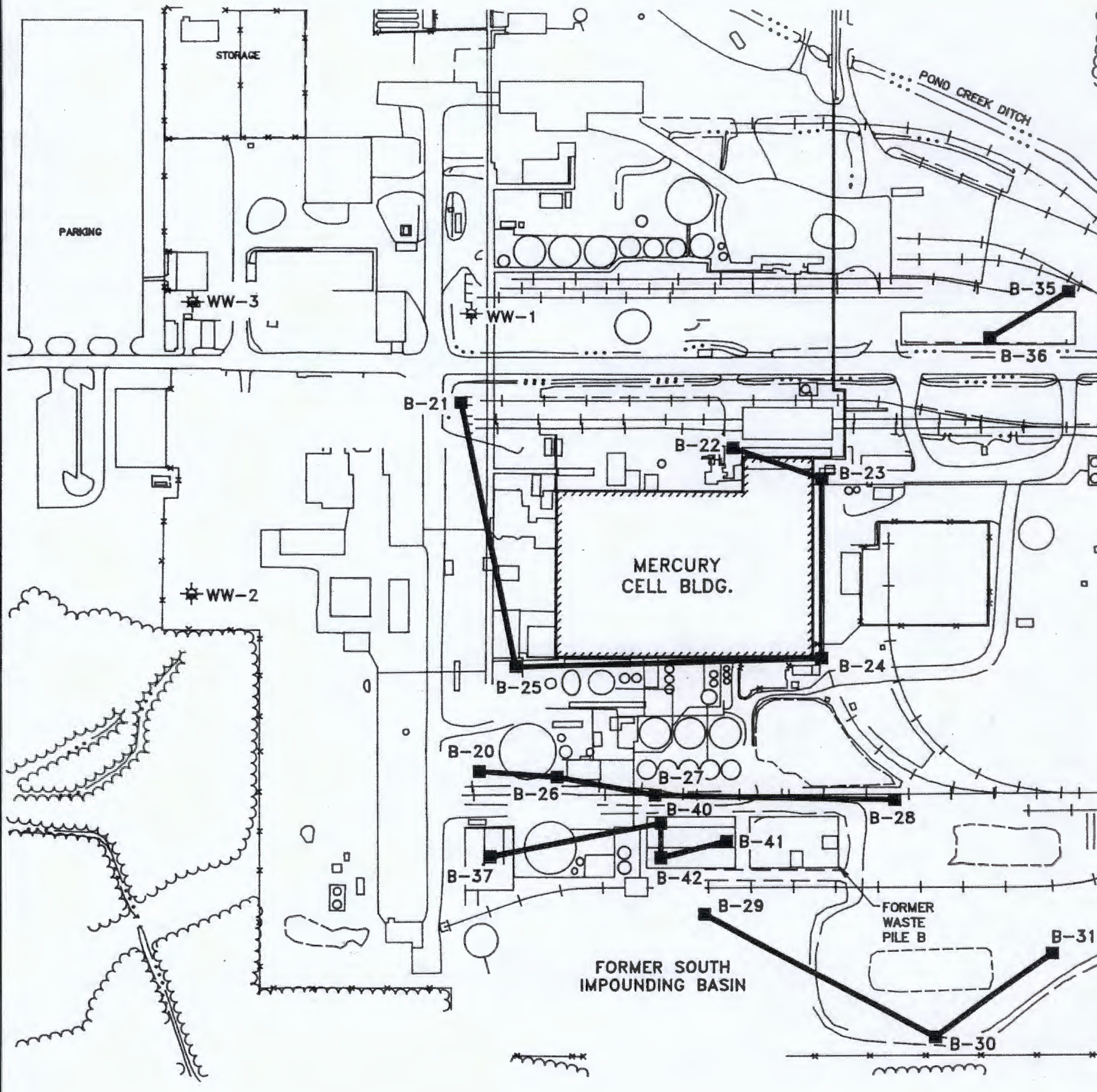
MUSCLE SHOALS, ALABAMA
Project Title

SITE HG AND CL SOIL PROFILES

3-7
Fig. No.

DRAWN BY	L.M.PITRE 6-8-92
CHECKED BY	6/25/92
APPROVED BY	6/25/92
DRAWING NO.	87-0188-B163



LEGEND

■ SOIL EXPLORATION BORING

DATE	NO.	REVISION	BY

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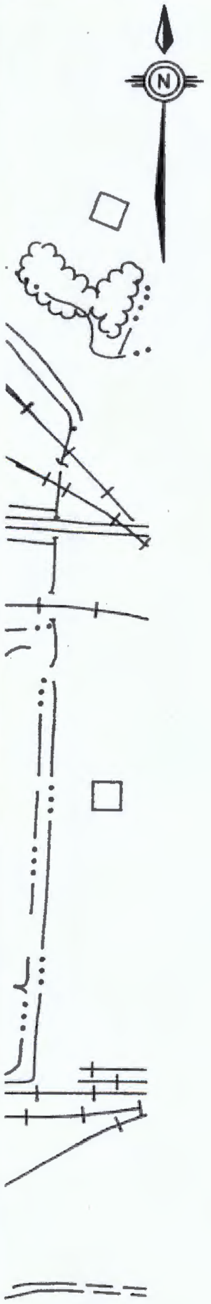

B-20

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	1.0	4,400
3 - 5	0.35	2,050
8 - 10	0.08	6,850
13 - 15	0.03	7,000
18 - 20	0.01	16,200
23 - 25	0.05	10,200
28 - 30	0.13	4,300
33 - 35	0.10	3,550

B-21

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	21.0	<10
3 - 5	0.14	<10
8 - 10	0.03	<10
13 - 15	0.04	<10
18 - 20	0.03	110
23 - 25	0.03	330
28 - 30	0.06	200
33 - 35	0.05	85
38 - 40	0.03	<10
43 - 45	0.09	<10
46 - 48	0.09	555

B-22

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	1.1	<10
3 - 5	0.09	<10
8 - 10	0.07	<10
13 - 15	0.34	<10

B-23

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.09	60
3 - 5	0.85	80
8 - 10	0.56	140
13 - 15	0.11	265

B-24

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.08	850
3 - 5	0.50	1,210
8 - 10	0.11	4,850
13 - 15	0.11	5,100

B-25

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.09	590
3 - 5	1.7	670
8 - 10	0.42	1,350
13 - 15	0.34	1,450

B-26

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	46.0	4,450
3 - 5	0.87	2,200
8 - 10	0.39	6,400
13 - 15	0.17	12,000

B-27

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
3 - 5	0.23	10,100
8 - 10	0.10	24,700
13 - 15	0.32	28,000

B-28

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.05	6,250
3 - 5	0.16	8,750
8 - 10	0.19	32,200
13 - 15	0.16	43,500

B-29

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	200	120
3 - 5	9.4	90
8 - 10	41.0	870
13 - 15	2.6	910

B-30

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	1.3	115
3 - 5	0.11	1,100
8 - 10	0.07	320
13 - 15	0.04	110

B-31

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.34	20
3 - 5	0.05	20
8 - 10	0.07	20
13 - 15	0.07	520

B-35

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)	Cd (mg/kg)
3			
4	0.044	16.5	2.6
9	0.026	10.1	2.3
14	0.036	12.1	1.7
19	0.074	16.3	1.9
25	0.078	4.2	2.0
29	0.072	3.2	2.0
34	0.070	2.6	1.9
39	0.035	5.6	1.7
44	0.018	5.0	1.8
49	0.033	15.7	3.0

B-36

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)	Cd (mg/kg)
3	0.067	2.4	2.5
4	0.050	6.6	2.7
9	0.069	46.1	2.6
14	0.091	23.8	2.5
19	0.090	195.0	2.5
25	0.060	338.0	2.1
29	0.064	379.0	3.7
34	0.055	184.0	2.6
39	0.088	48.0	2.8
44	0.132	26.2	4.2
49	0.017	38.1	2.8

B-37

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)	Cd (mg/kg)
3	25.2	269	2.5
4	42:1	92.7	2.2
9	12.5	169	2.4
14	1.47	173	2.7
19	0.109	4740	3.0
24	0.125	5240	3.0
29	0.242	6720	2.3
34	0.108	4810	2.2
39	0.118	6340	2.9
44	0.124	1160	1.7
49	0.051	669	2.6

B-40

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)	Cd (mg/kg)
4	10.1	1430	3.0
5	14.0		
7	16.2		
9	0.830	2250	2.6
11	1.0		
13	1.2		
14	0.426	3530	3.5
17	0.300		
19	0.343	4320	3.9
24	0.294	5440	2.5
29	0.278	2930	2.1
34	0.293	3030	2.7
39	0.385	3320	2.8
44	0.312	2520	2.7

B-41

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)	Cd (mg/kg)
4	6.74	727	7.3
9	0.480	1970	3.2
11	0.800		
13	0.250		
14	0.081	3290	2.2
17	0.240		
19	0.315	5220	3.2
24	0.642	5300	3.3
29	0.482	3280	2.0
34	0.863	3910	2.7
39	1.59	2350	2.4

B-42

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)	Cd (mg/kg)
2	3.2		
3	27.1	27.4	5.7
4	2.9	60.4	2.9
5	5.85		
7	1.35		
9	0.239	103	3.9
11	1.1		
13	0.180		
14	0.175	2710	4.1
17	0.160		
19	0.228	2490	2.8
24	0.984	5010	3.1
29	0.679	1950	2.6
34	0.234	311	2.9
39	0.085	.424	2.9
44	0.171	611	2.7

0 feet 250
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MUSCLE SHOALS, ALABAMA
Project Title

PROCESS AREA
HG AND CL SOIL PROFILES

3-8
Fig. No.

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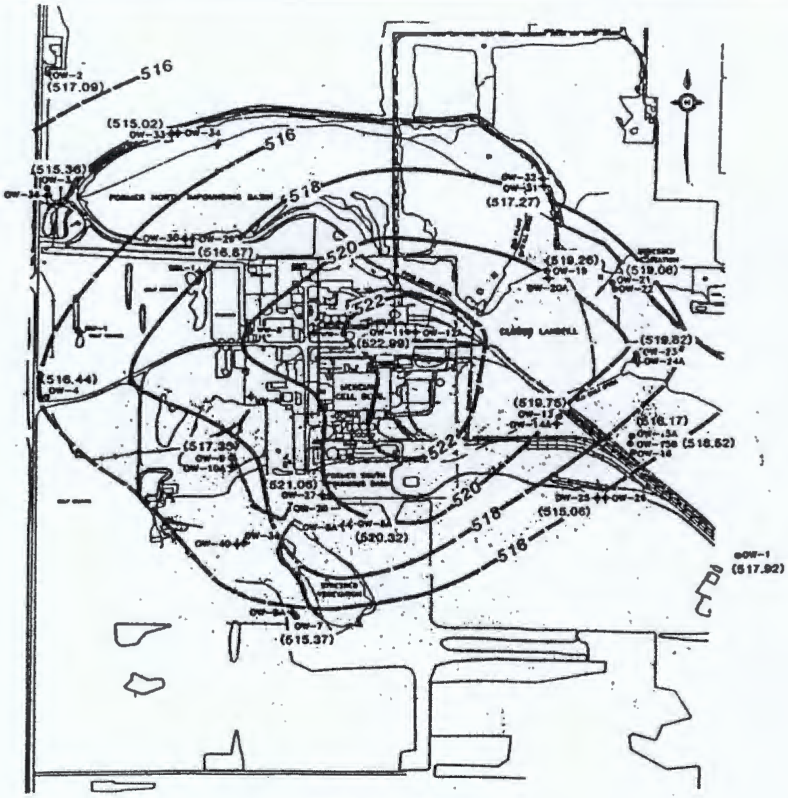
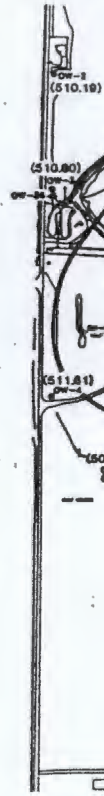
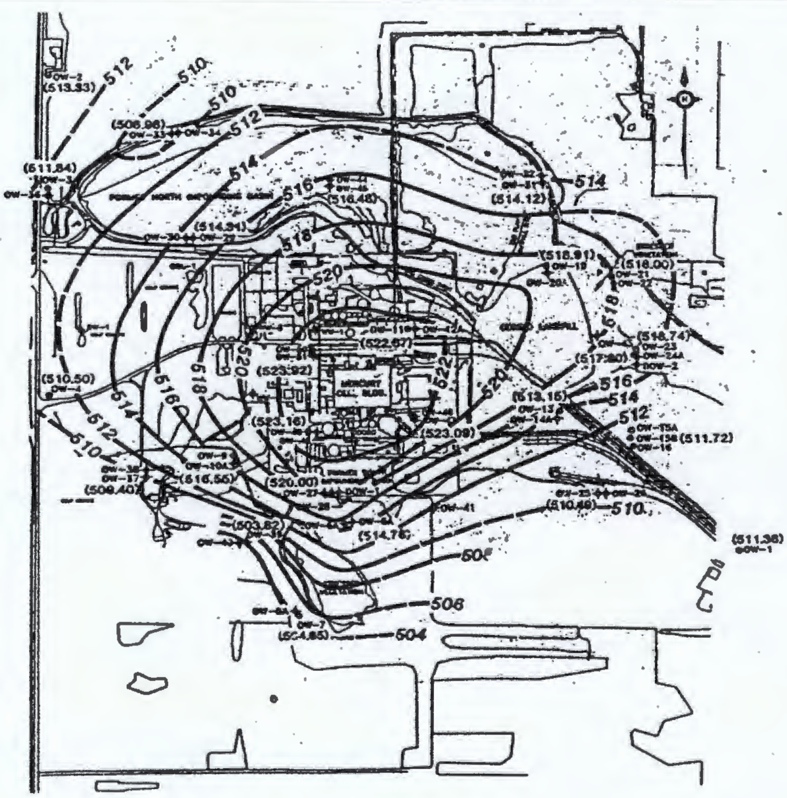
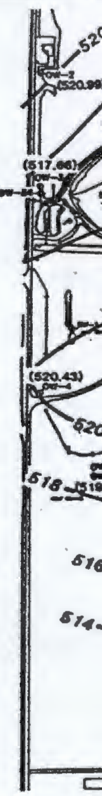




MAY 1988





OCTOBER 1988

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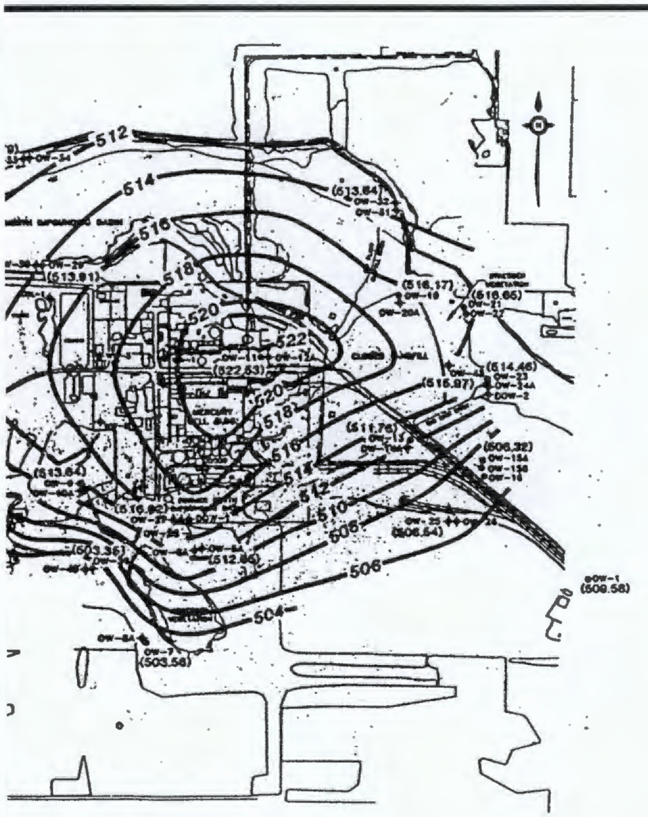
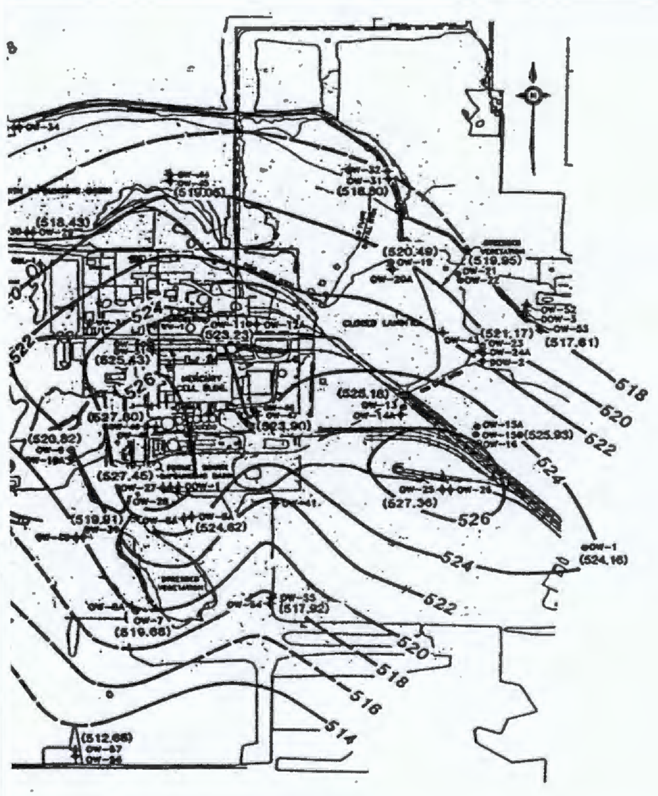


JULY 1988



JANUARY 1989

LEGEND

(517.09) ELEVATION, FT. MSL

—*520*— POTENTIOMETRIC CONTOUR, FT. MSL

0 feet 1200

SCALE

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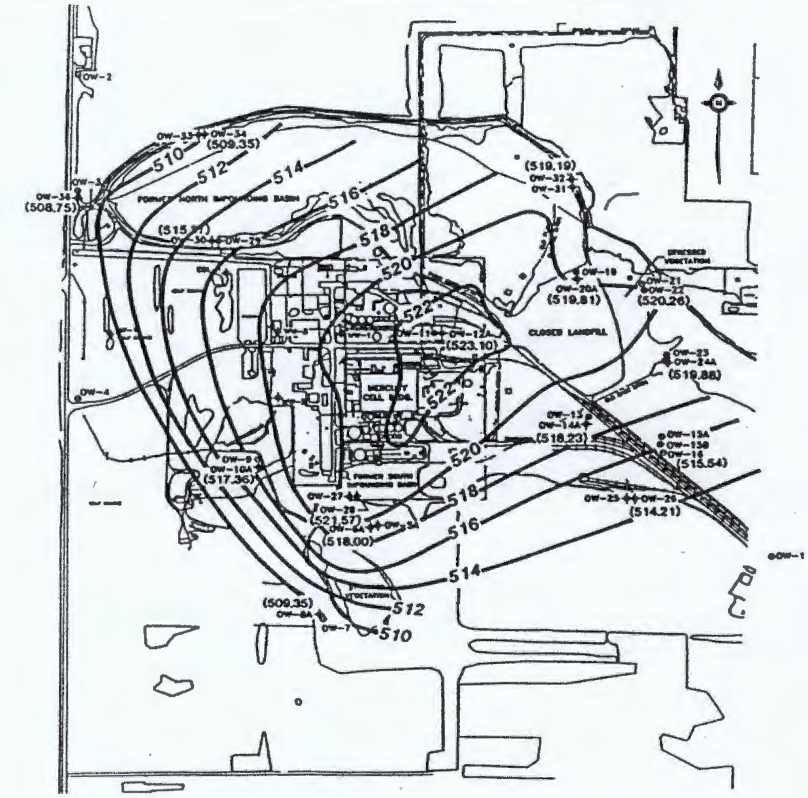
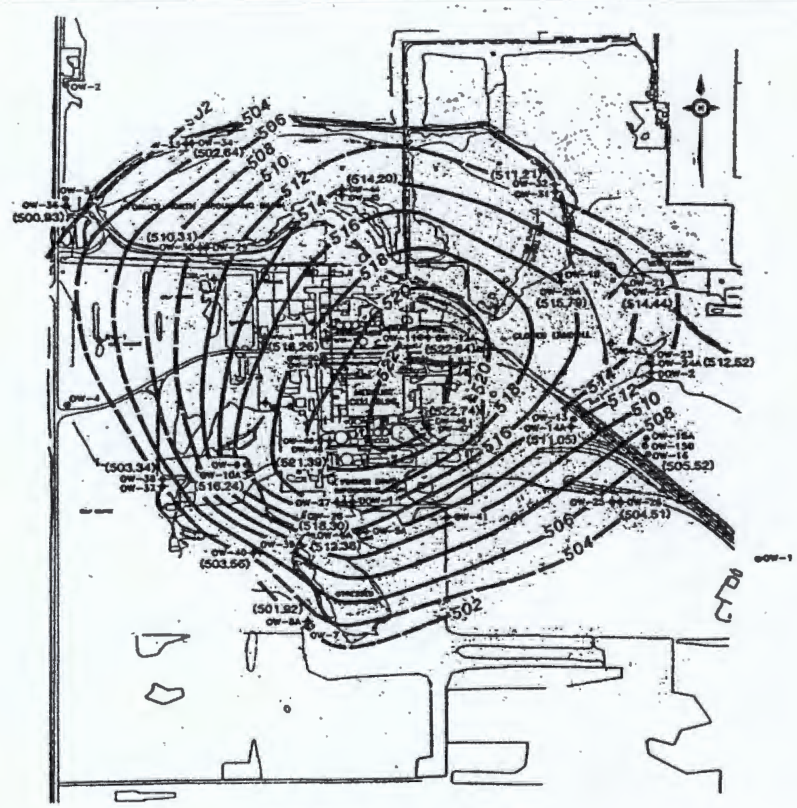
OCCIDENTIAL CHEMICAL **CHLOR-ALKALI FACILITY** MUSCLE SHOALS, ALABAMA Project Title	**SEASONAL UPPER ZONE** **POTENTIOMETRIC CONTOURS**	**3-9** Fig. No.

DRAWN BY	L.M. PITRE 5-27-92	CHECKED BY / APPROVED BY	6/25/92 6/25/92	DRAWING NO.	87-0188-B63



MAY 1988



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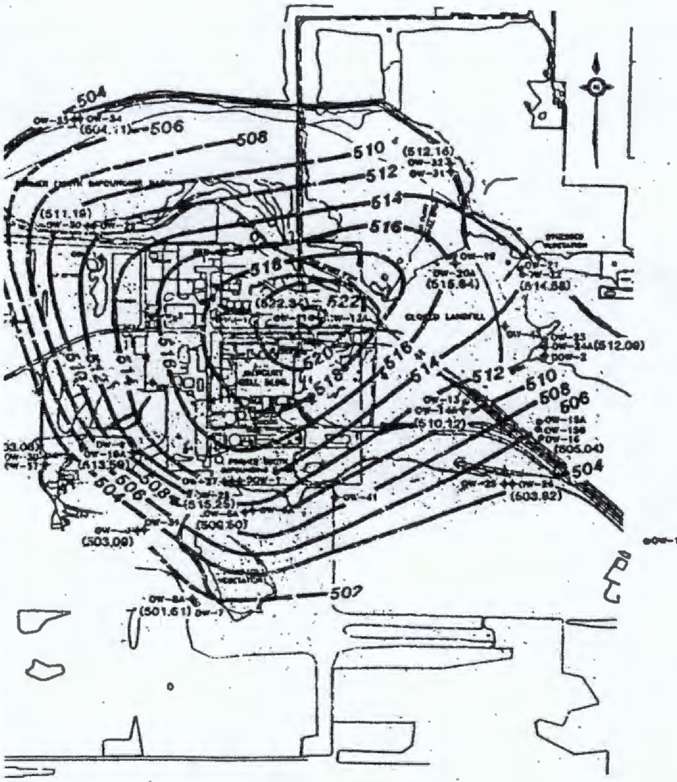

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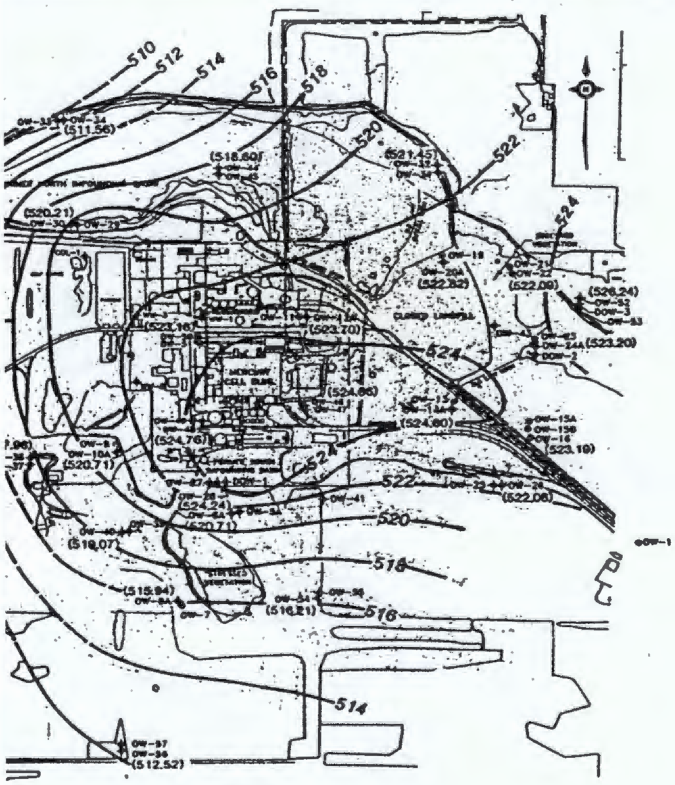

JANUARY 1989

LEGEND

(517.09) ELEVATION, FT. MSL

520 POTENTIOMETRIC CONTOUR, FT. MSL

0 feet 1200

SCALE

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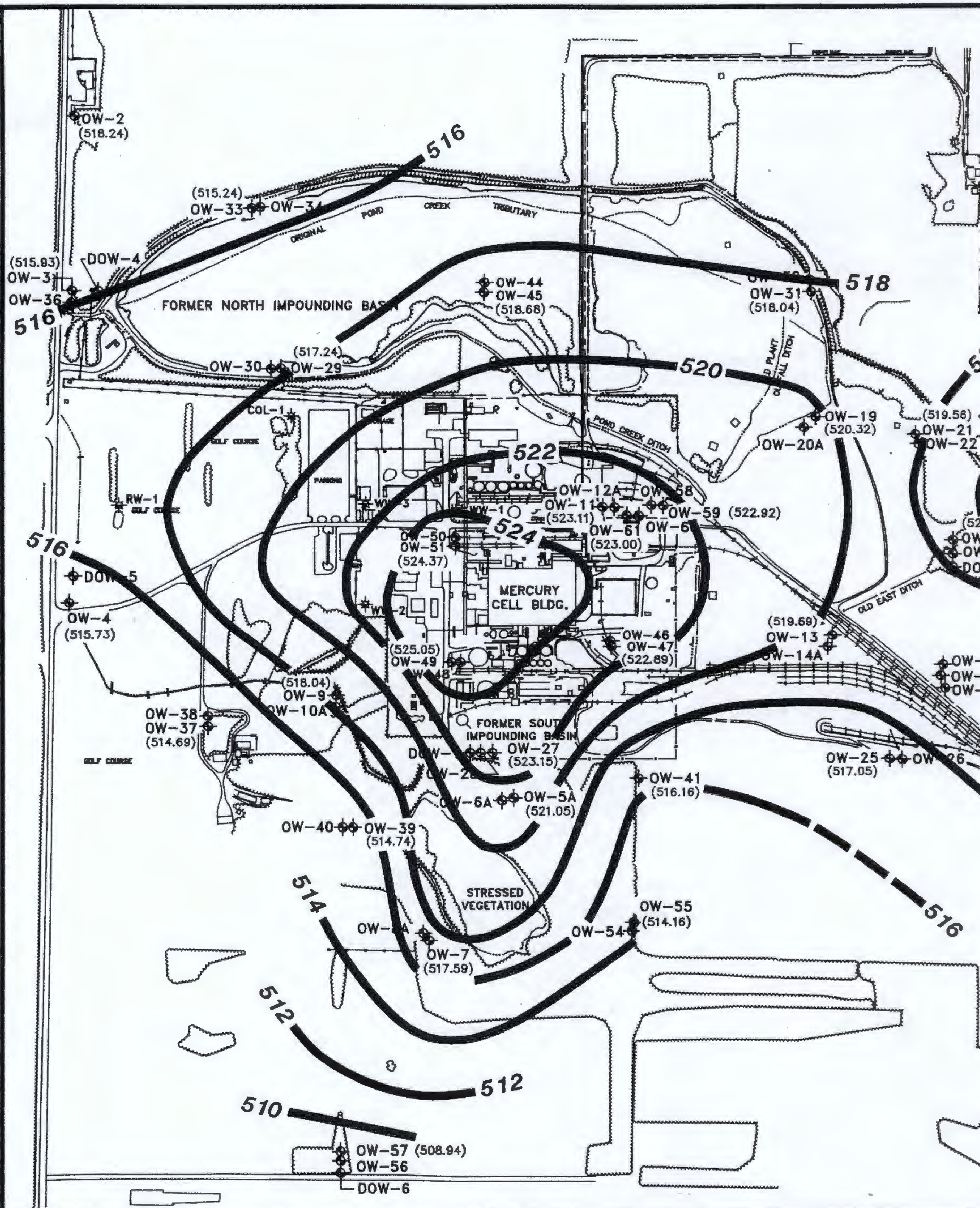
MUSCLE SHOALS, ALABAMA
Project Title

SEASONAL LOWER ZONE
POTENTIOMETRIC CONTOURS

3-10
Fig. No.

DRAWING NO. 87-0188-B153

DRAWN BY	CHECKED BY	APPROVED BY
L.M.PITRE 5-7-92		

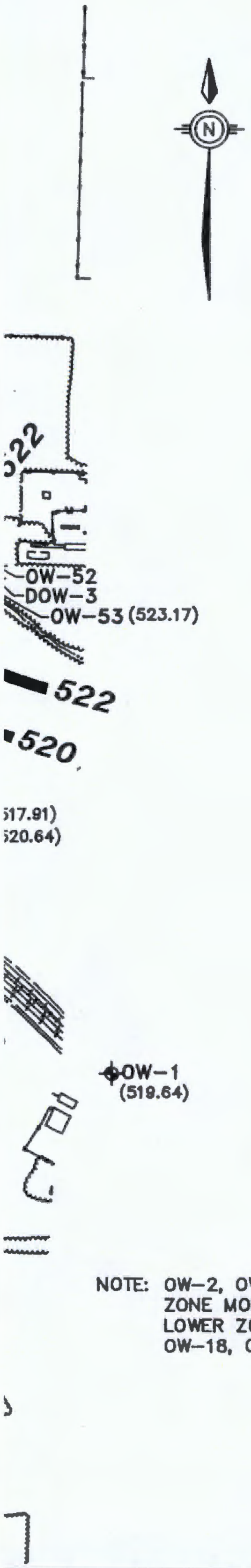


DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATI

NIAGARA FALLS, NEW YORK

Client



LEGEND

⌖	MONITOR WELL LOCATION
⌖	WATER WELL (ABANDONED/CLOSED)
(519.64)	GROUNDWATER ELEVATION, FT. MSL
—512—	GROUNDWATER ELEVATION CONTOUR FT. MSL

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

0 feet 600
SCALE

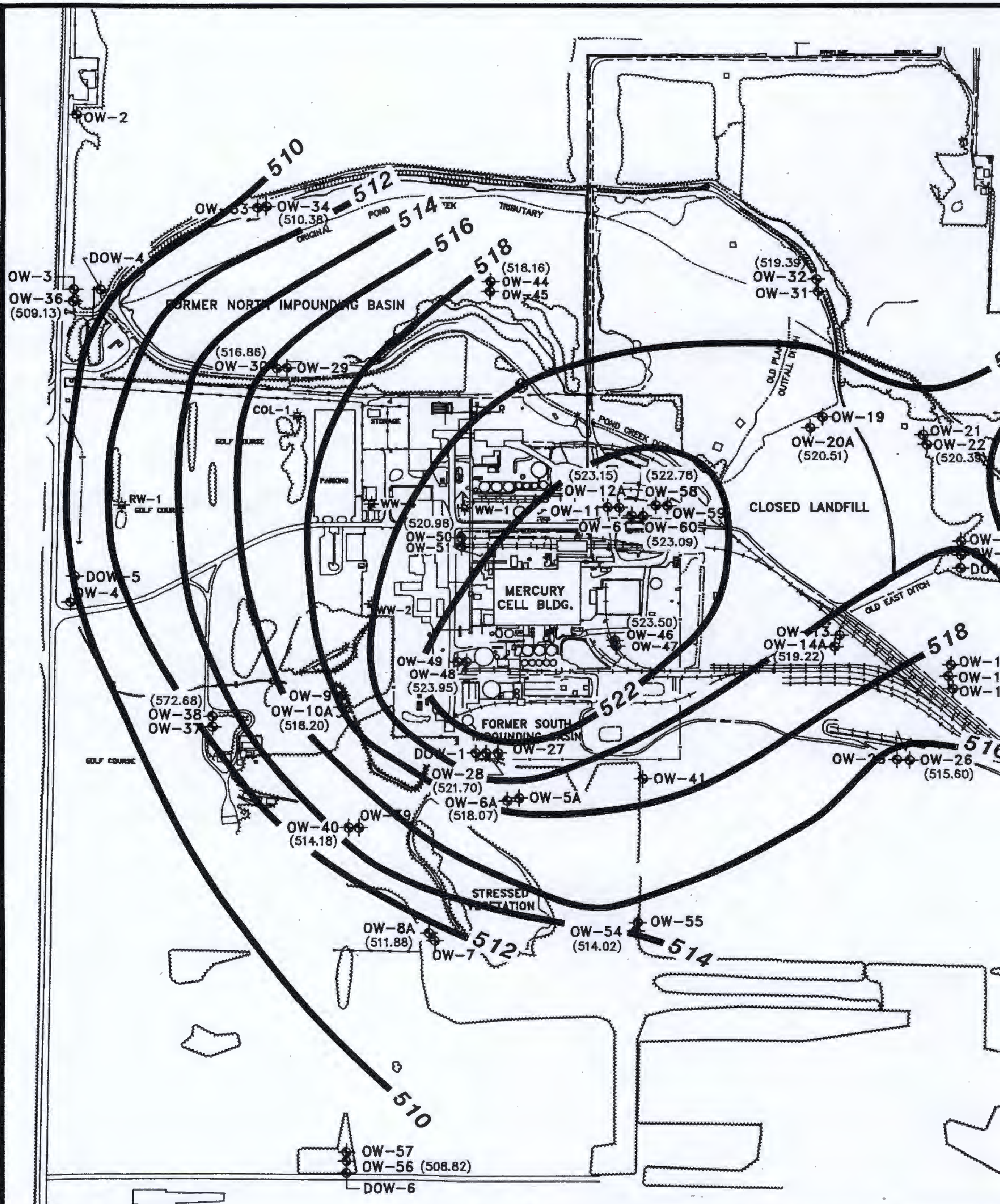
G&E
ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

UPPER ZONE
POTENTIOMETRIC CONTOURS
APRIL 1992

3-11
Fig. No.

DRAWN BY | L.M.PITRE | 5-7-92
CHECKED BY | [initials] | 6/25/92
APPROVED BY | [initials] | 6/25/92
DRAWING NO. 87-0188-B152



DATE	NO.	REVISION	BY

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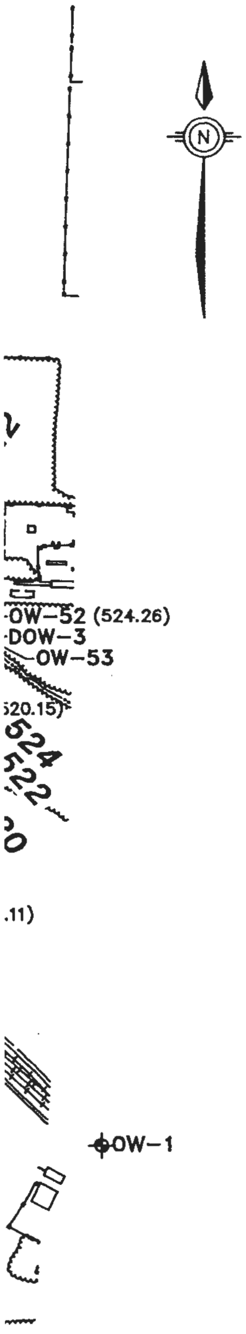
NIAGARA FALLS, NEW YORK
Client



LEGEND

⌖	MONITOR WELL LOCATION
✻	WATER WELL (ABANDONED/CLOSED)
(517.11)	GROUNDWATER ELEVATION, FT. MSL
— 510 —	GROUNDWATER ELEVATION CONTOUR FT. MSL

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW--42 AND OW-43 NOT USED.

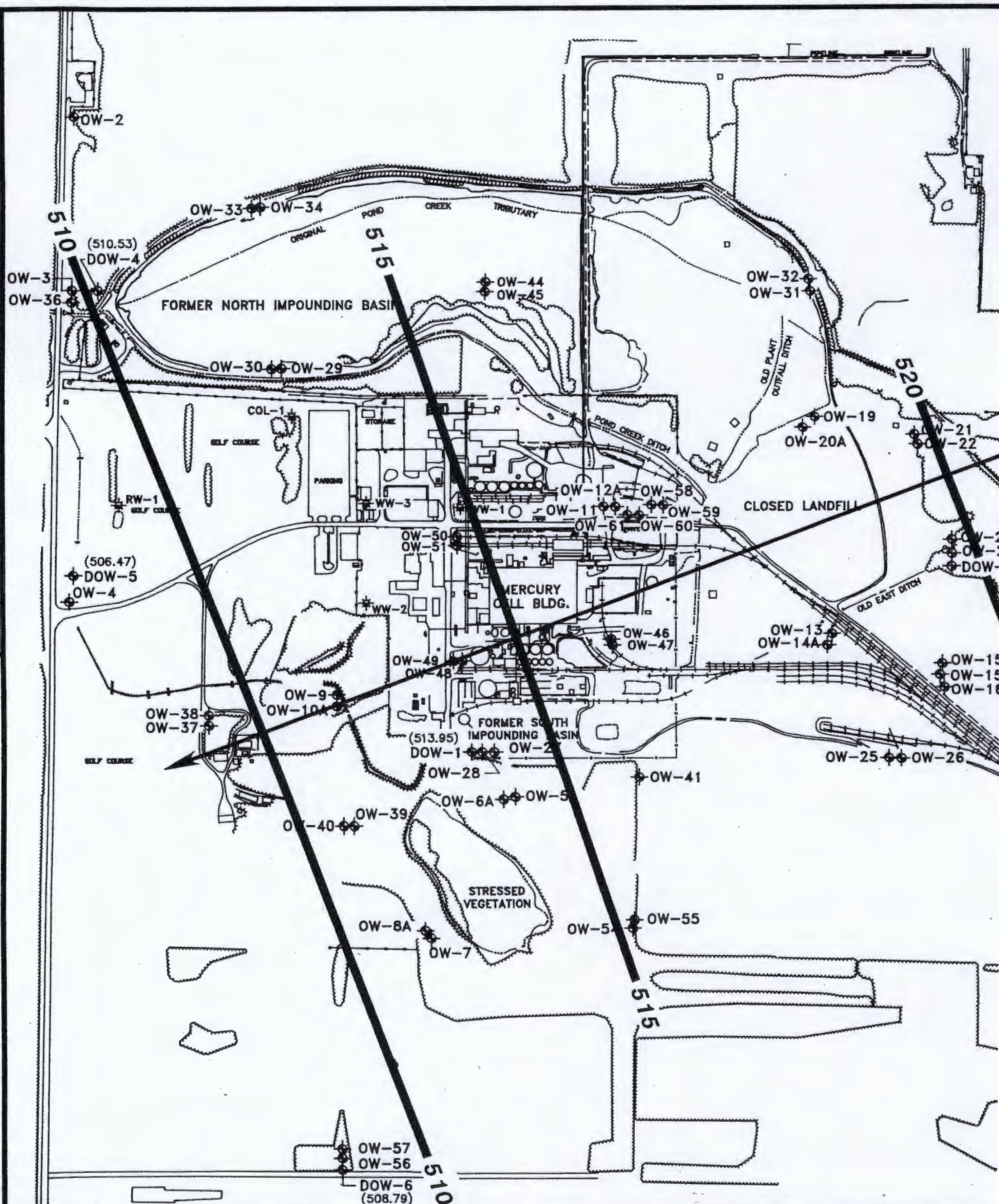
0 feet 600
SCALE

G&E ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

LOWER ZONE POTENTIOMETRIC CONTOURS APRIL 1992

3-12
Fig. No.



DRAWING NO. 87-0188-B154

DRAWN BY	L.M.PITRE	5-7-92	CHECKED BY	APPROVED BY	6/25/92	6/25/92

DATE	NO.	REVISION	BY

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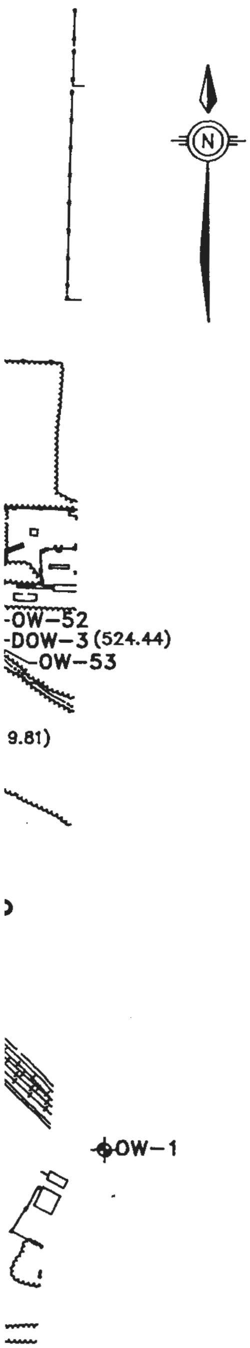
NIAGARA FALLS, NEW YORK

Client



LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- (519.81) GROUNDWATER ELEVATION, FT. MSL
- 510 GROUNDWATER ELEVATION CONTOUR FT. MSL
- GROUNDWATER FLOW DIRECTION

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

0 feet 600

SCALE

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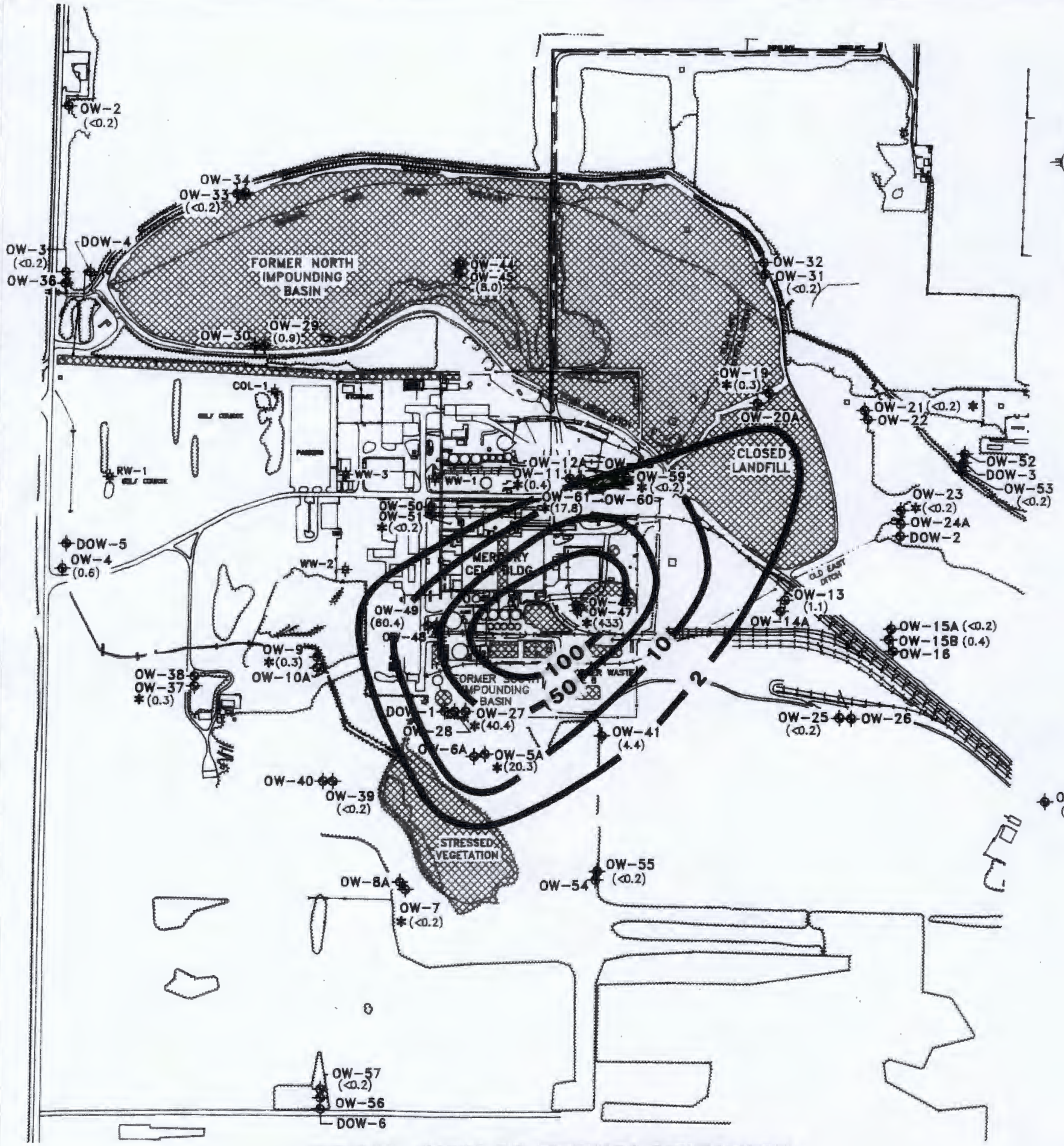
OCCIDENTAL CHEMICAL
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

DEEP ZONE
POTENTIOMETRIC CONTOURS
APRIL 1992

3-13
Fig. No.



TOTAL (NON-FILTERED) MERCURY

LEGEND

MONITOR WELL LOCATION

WATER WELL (ABANDONED/CLOSED)

(8.9) MERCURY CONCENTRATION, ug/l

—2— MERCURY ISOPLETH, ug/l

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NIAGARA FALLS, NEW YORK

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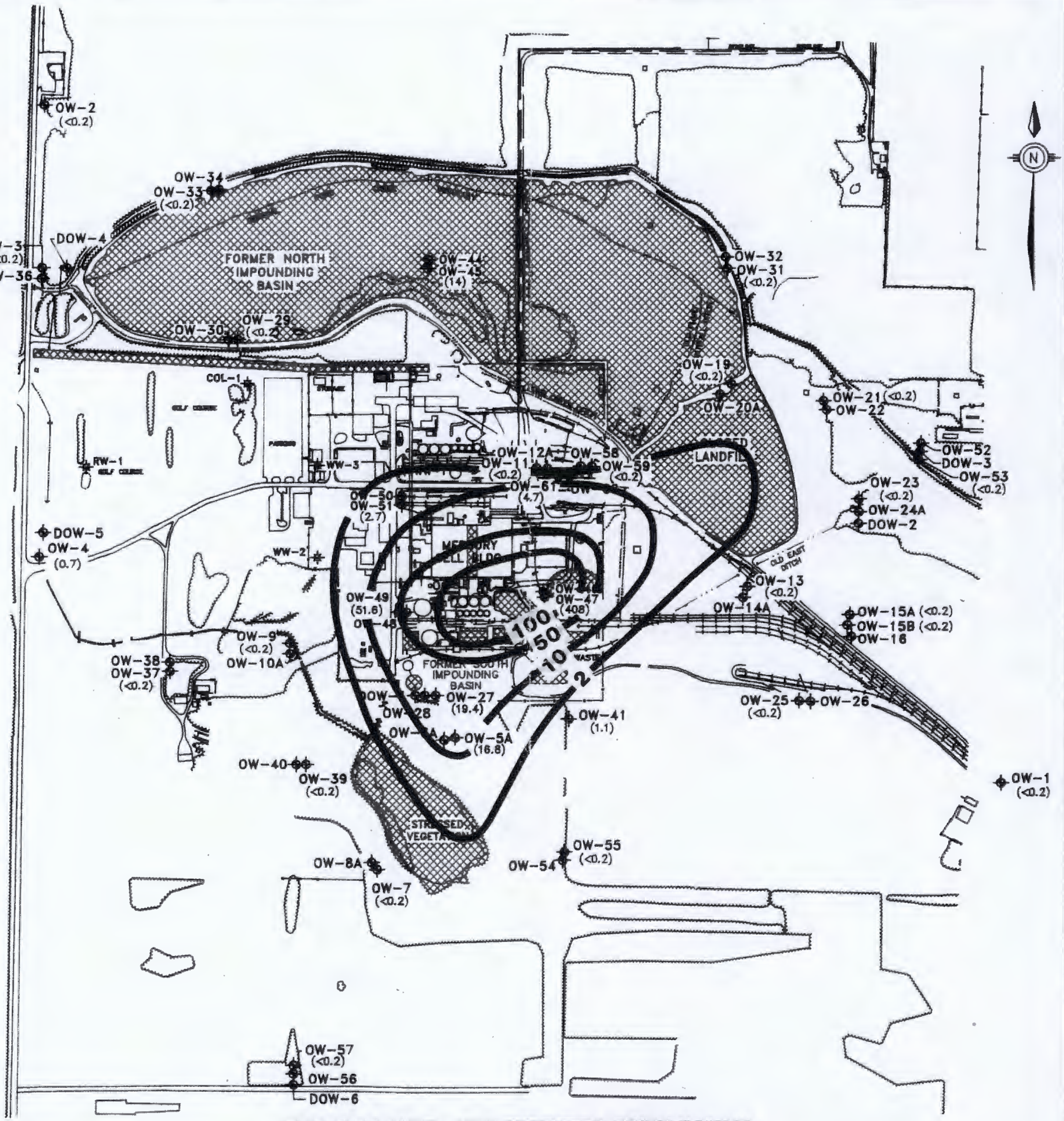
DRAWN BY	L.M.PITRE	6-23-92
CHECKED BY		
APPROVED BY		
DRAWING NO.	87-0188-B204	



DISSOLVED (FILTERED) MERCURY

NOTES: 1) OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

* 2) INDICATES THAT THE CONCENTRATION IS THE AVERAGE BETWEEN 4 REPLICATES.

feet 700

SCALE

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ENVIRONMENTAL CONSULTANTS

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MUSCLE SHOALS, ALABAMA
Project Title

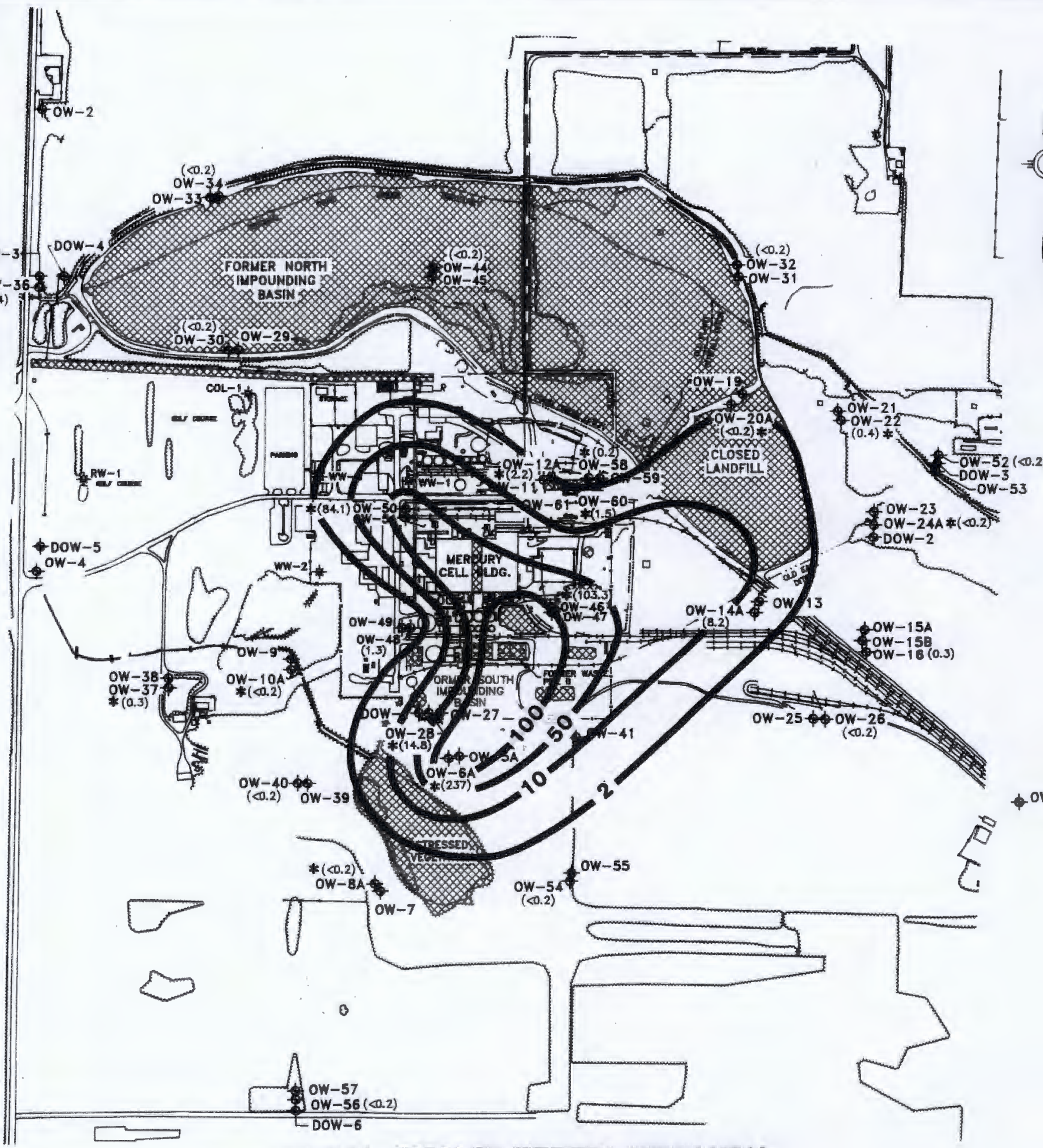
UPPER ZONE MERCURY CONCENTRATIONS AND ISOPLETHS APRIL 1992

3-14
Fig. No.

DRAWING NO. 87-0188-B205

CHECKED BY / APPROVED BY

DRAWN BY L.M.PITRE 6-23-92



TOTAL (NON-FILTERED) MERCURY

LEGEND

◆	MONITOR WELL LOCATION	(8.9)	MERCURY CONCENTRATION, ug/l
✱	WATER WELL (ABANDONED/CLOSED)	—5—	MERCURY ISOPLETH, ug/l

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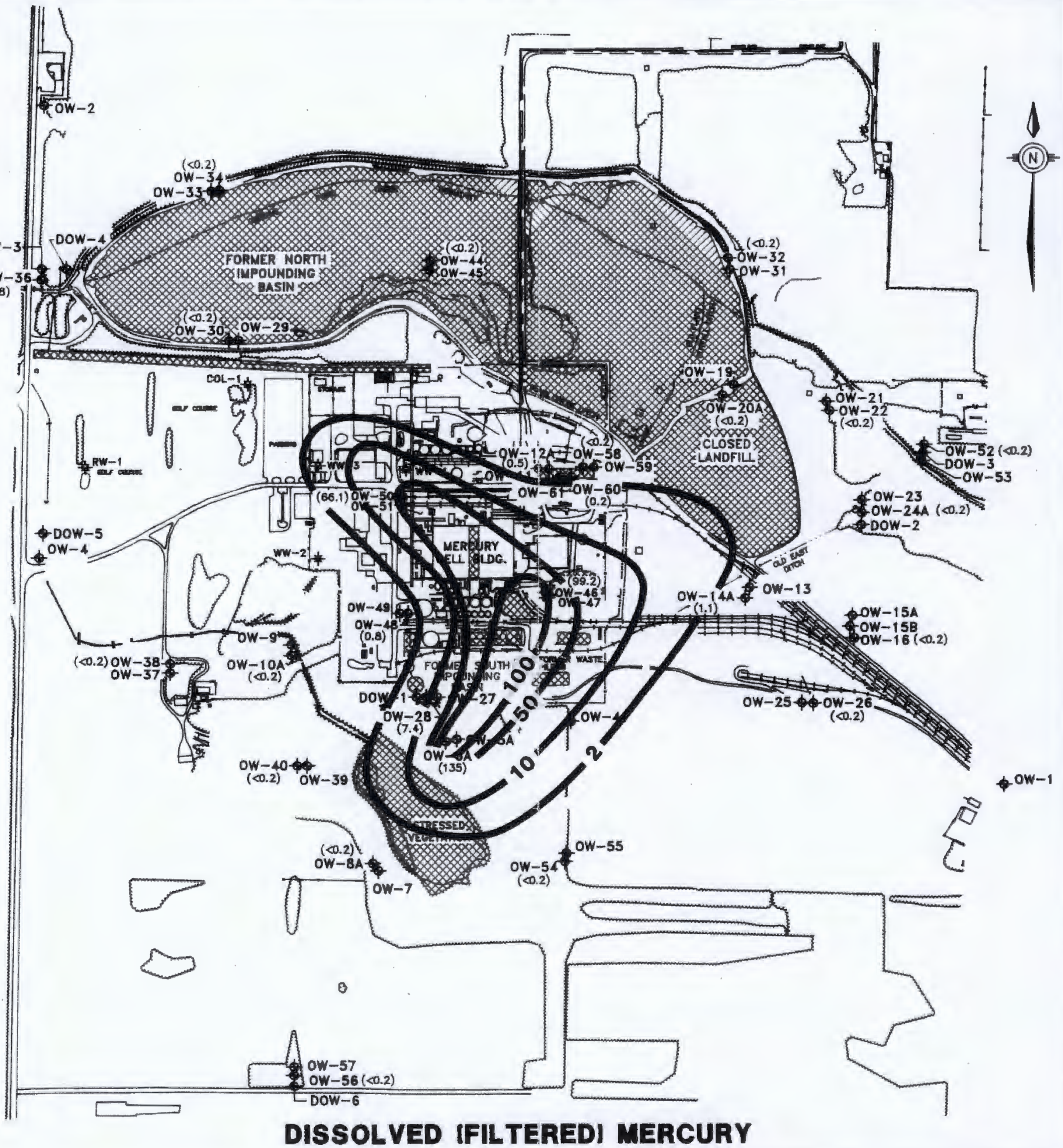
OCCIDENTAL CHEMICAL CORPORAT

NIAGARA FALLS, NEW YORK

Client



DISSOLVED (FILTERED) MERCURY

NOTES: 1) OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

* 2) INDICATES THAT THE CONCENTRATION IS THE AVERAGE BETWEEN 4 REPLICATES.

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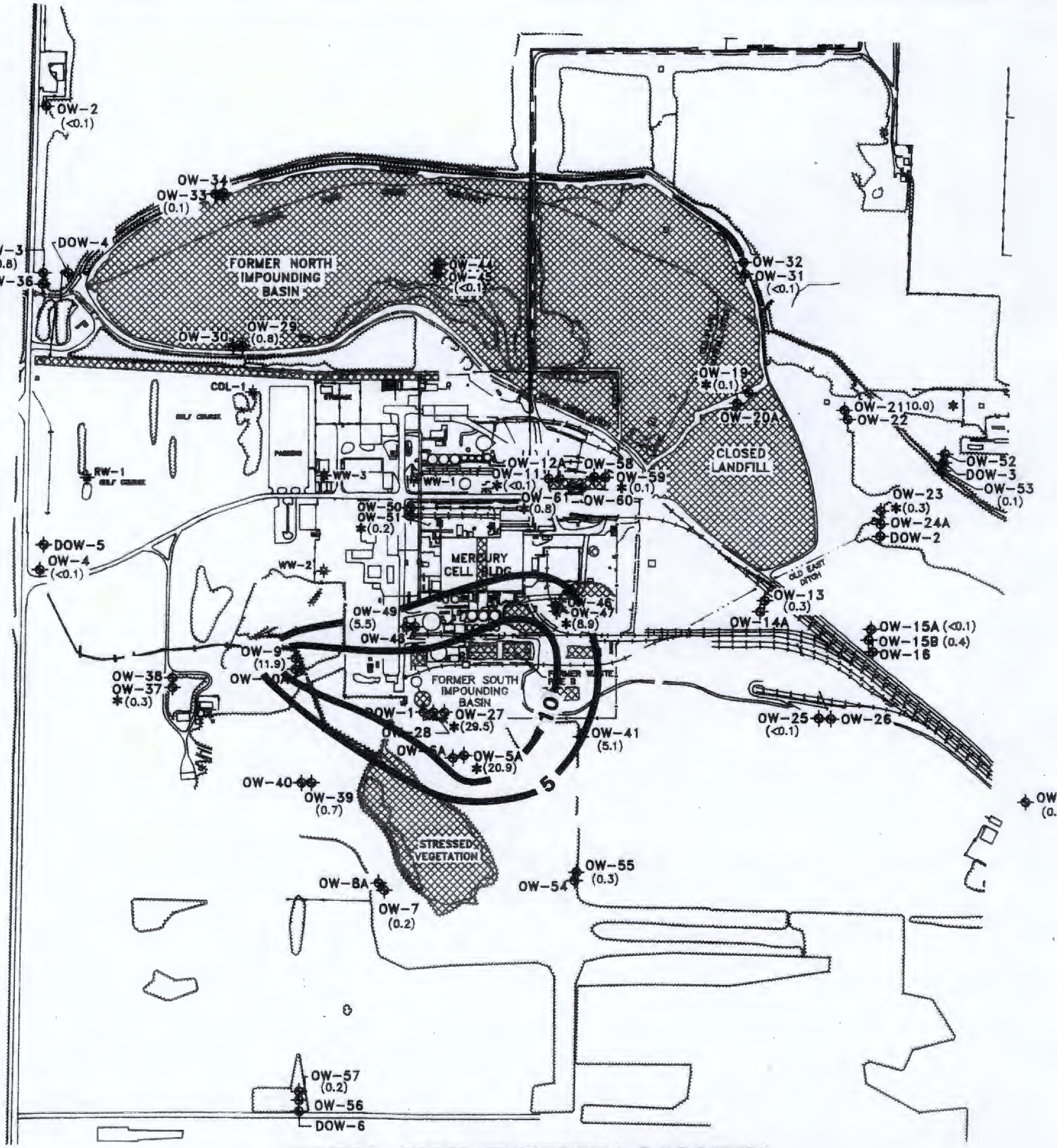
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

LOWER ZONE MERCURY CONCENTRATIONS AND ISOPLETHS
APRIL 1992

3-15
Fig. No.

DRAWN BY	L.M.PITRE 6-24-92
CHECKED BY / APPROVED BY	6/25/92 6/25/92
DRAWING NO.	87-0188-B207



TOTAL (NON-FILTERED) CADMIUM

LEGEND

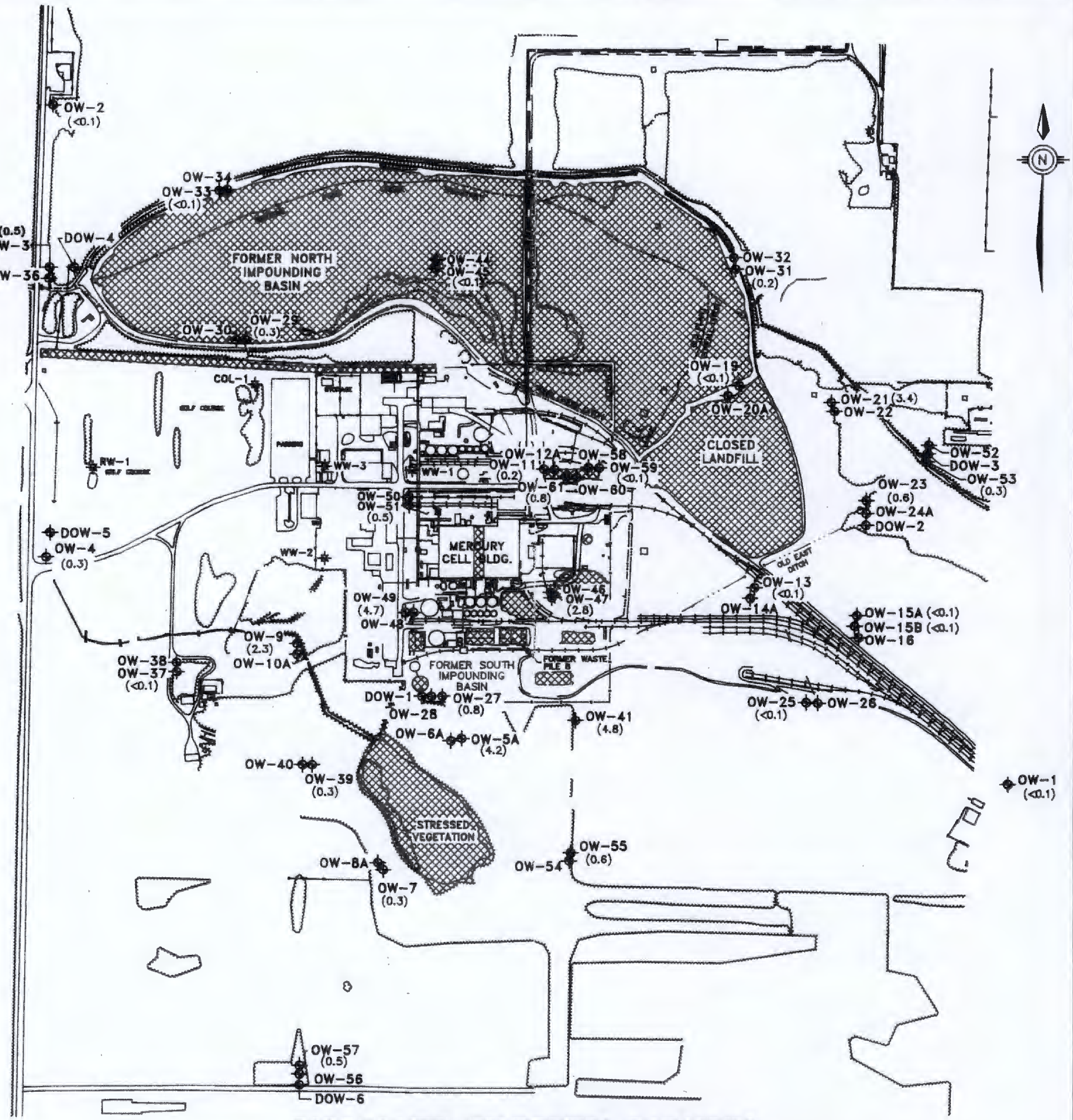
- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- (8.9) CADMIUM CONCENTRATION, ug/l
- —5— CADMIUM ISOPLETH, ug/l

DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATI

NIAGARA FALLS, NEW YORK

Client



DISSOLVED (FILTERED) CADMIUM

NOTES:
1) OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.
* 2) INDICATES THAT THE CONCENTRATION IS THE AVERAGE BETWEEN 4 REPLICATES.

feet 700
SCALE

G&E ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

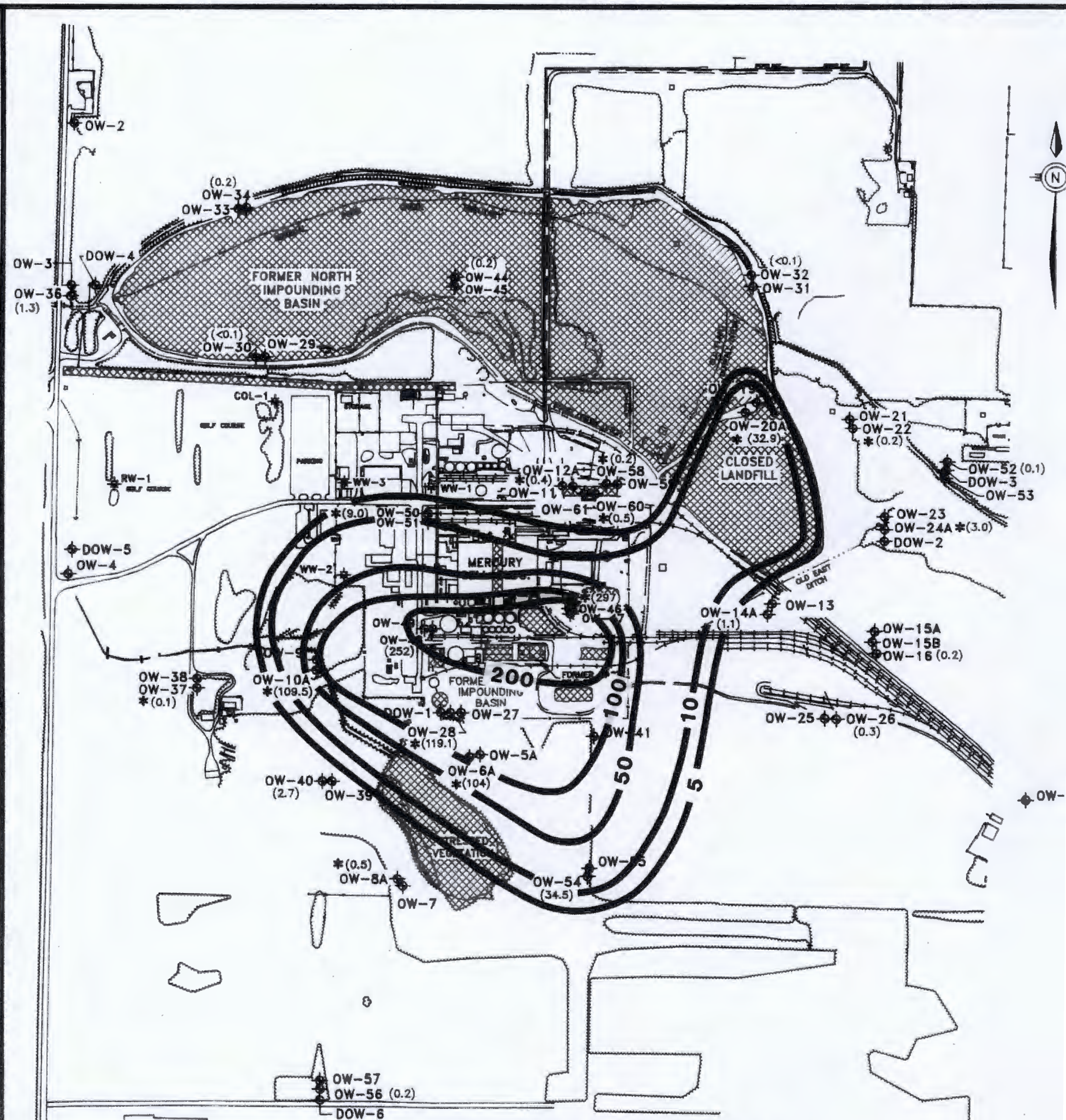
OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

UPPER ZONE CADMIUM CONCENTRATIONS AND ISOPLETHS APRIL 1992

3-16
Fig. No.

DRAWING NO. 87-0188-B206

DRAWN BY	CHECKED BY / APPROVED BY
L.M.PITRE 8-24-92	



TOTAL (NON-FILTERED) CADMIUM

LEGEND

✦	MONITOR WELL LOCATION	(8.9)	CADMIUM CONCENTRATION, ug/l
✱	WATER WELL (ABANDONED/CLOSED)	—5—	CADMIUM ISOPLETH, ug/l

DATE	NO.	REVISION	BY

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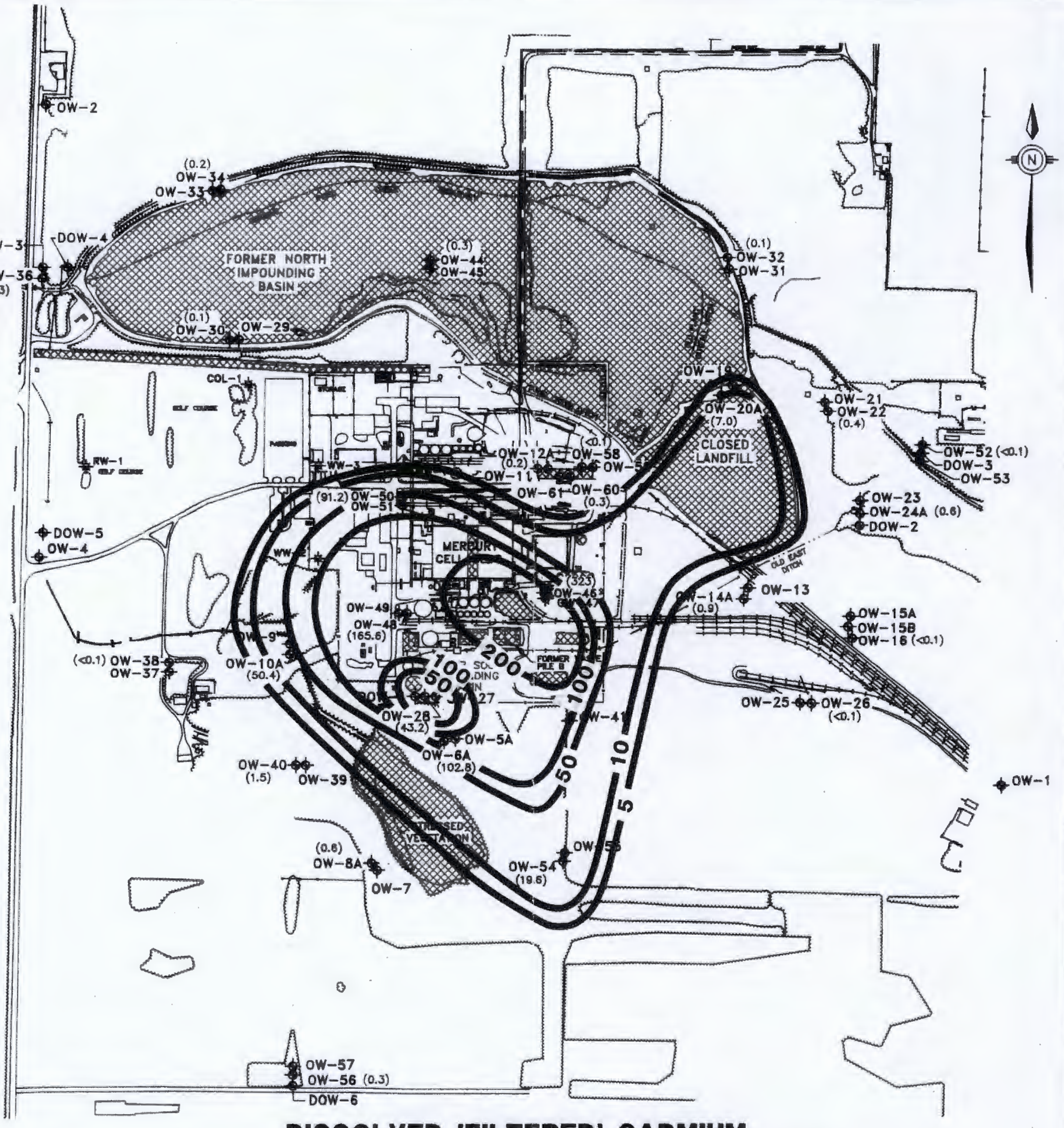
NIAGARA FALLS, NEW YORK

Client



DISSOLVED (FILTERED) CADMIUM

NOTES: 1) OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

* 2) INDICATES THAT THE CONCENTRATION IS THE AVERAGE BETWEEN 4 REPLICATES.

feet 700

SCALE

G&E ENGINEERING, INC.

ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY

MUSCLE SHOALS, ALABAMA

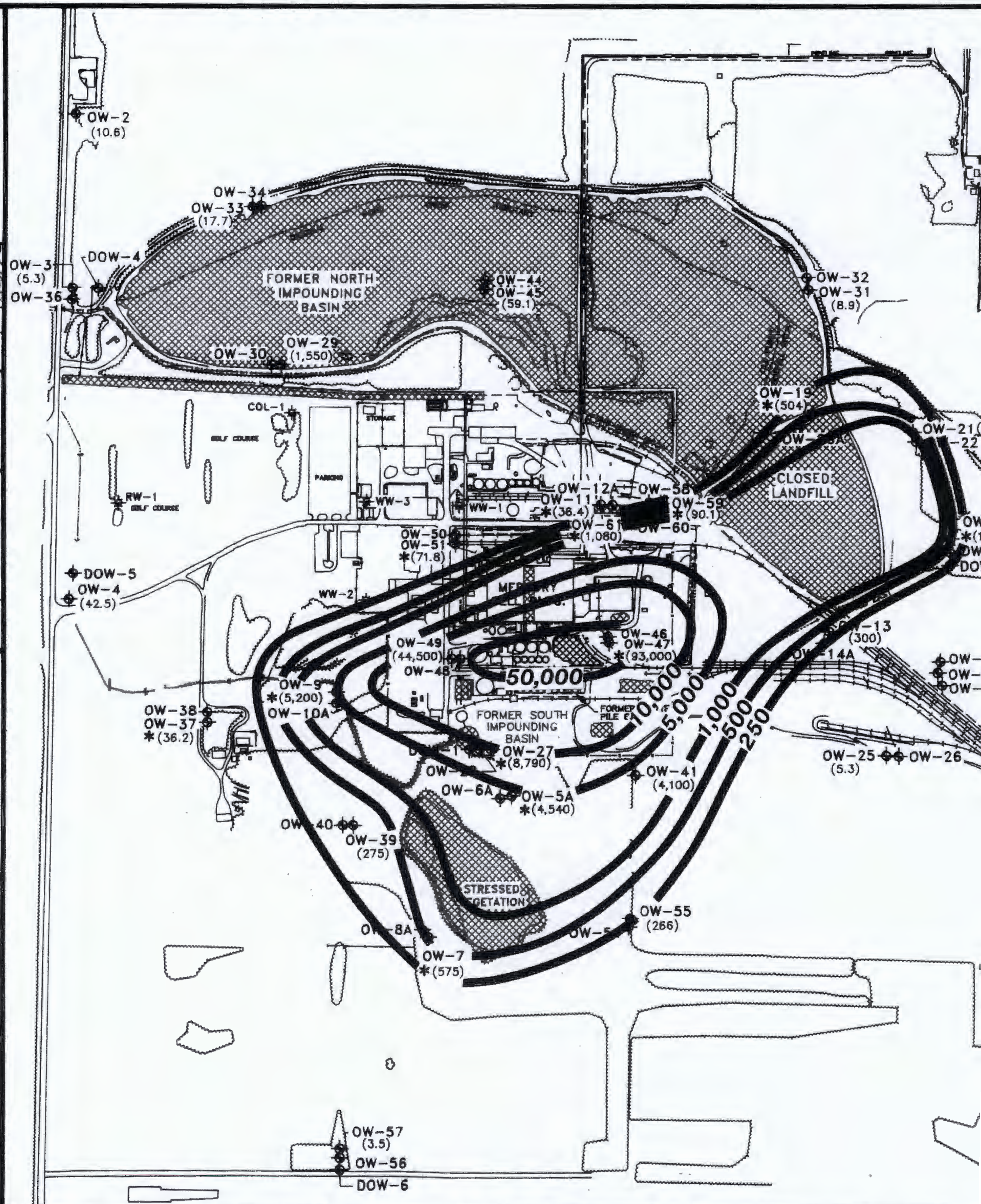
Project Title

LOWER ZONE CADMIUM CONCENTRATIONS AND ISOPLETHS APRIL 1992

3-17

Fig. No.

DRAWN BY A.B. LAPRARIE 5-29-92
CHECKED BY
APPROVED BY
DRAWING NO. 87-0188-B166



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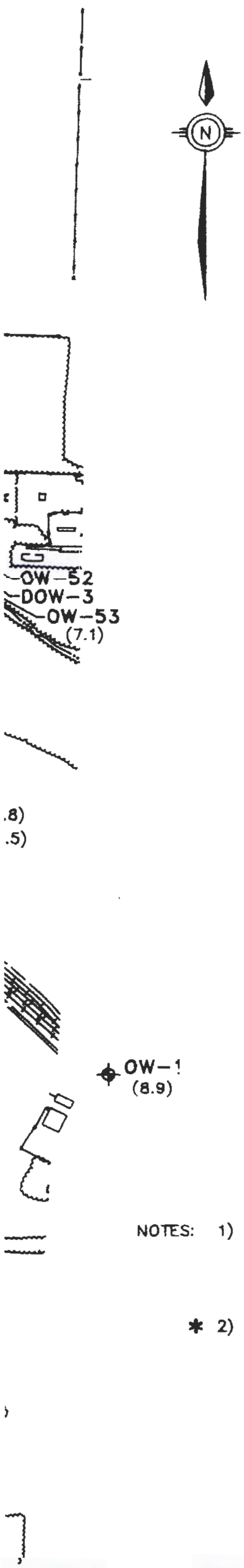
OCCIDENTAL CHEMICAL CORPORATI

NIAGARA FALLS, NEW YORK

Client



LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- SOLID WASTE MANAGEMENT UNIT (SWMU) OR AREA OF CONCERN (AOC)
- (8.9) CHLORIDE CONCENTRATION, mg/l
- 250 CHLORIDE ISOPLETH, mg/l

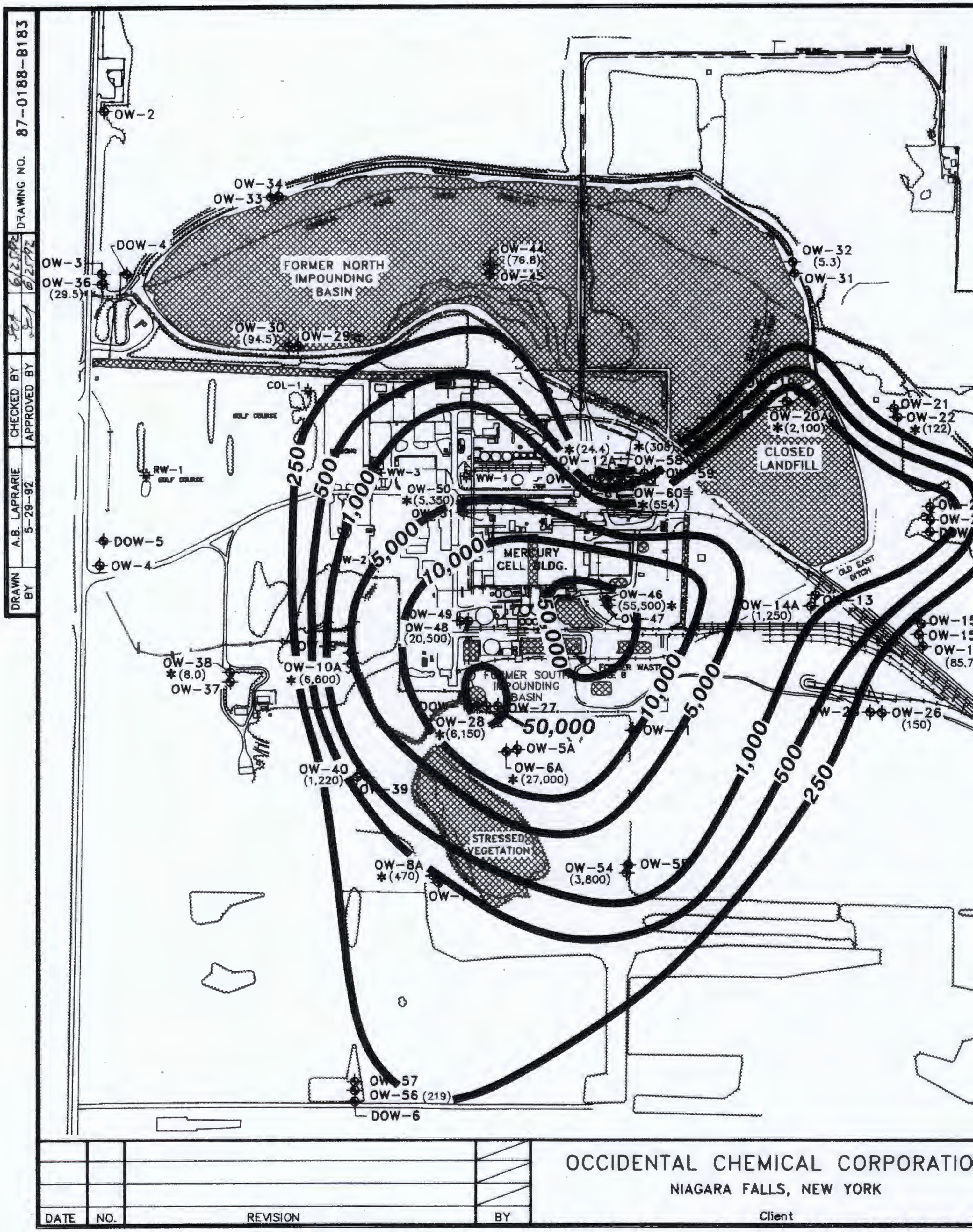
NOTES: 1) OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

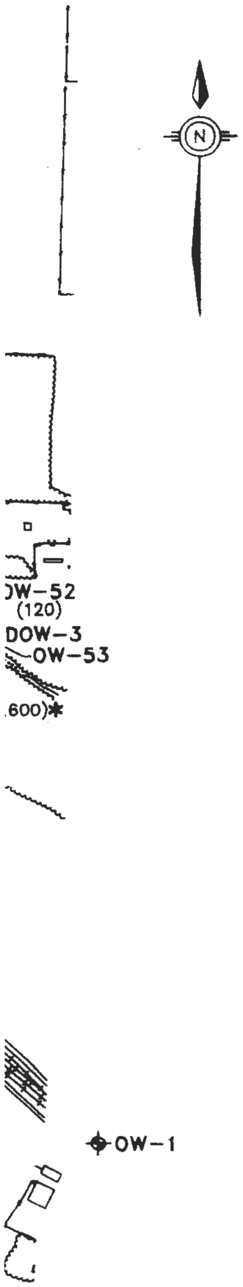
* 2) INDICATES THAT THE CONCENTRATION IS THE AVERAGE BETWEEN 4 REPLICATES.

0 feet 600

SCALE

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**G&E ENGINEERING, INC.** ENVIRONMENTAL CONSULTANTS **UPPER ZONE CHLORIDE CONCENTRATIONS ISOPLETHS APRIL 1992**	**3-18** Fig. No.


DRAWING NO. 87-0188-B183
DRAWN BY A.B. LAPRARIE 5-29-92
CHECKED BY
APPROVED BY
FORMER NORTH IMPOUNDING BASIN
CLOSED LANDFILL
MERCURY CELL BLDG.
FORMER SOUTH IMPOUNDING BASIN
STRESSED VEGETATION
OLD EAST DITCH
GOLF COURSE
OW-2
OW-34
OW-33
DOW-4
OW-3
OW-36 (29.5)
OW-44 (76.8)
OW-45
OW-32 (5.3)
OW-31
OW-30 (94.5)
OW-29
COL-1
RW-1
WW-3
WW-1
OW-50 (5,350)
OW-12A (24.4)
OW-58 (308)
OW-59
OW-60 (554)
OW-20A (2,100)
OW-21
OW-22 (122)
DOW-5
OW-4
OW-46 (55,500)
OW-47
OW-14A (1,250)
OW-13
OW-49
OW-48 (20,500)
OW-38 (8.0)
OW-37
OW-10A (6,600)
OW-28 (6,150)
OW-27
OW-5A
OW-6A (27,000)
OW-26 (150)
OW-40 (1,220)
OW-39
OW-8A (470)
OW-54 (3,800)
OW-57
OW-56 (219)
DOW-6
250
500
1,000
5,000
10,000
50,000
DATE
NO.
REVISION
BY
OCCIDENTAL CHEMICAL CORPORATIO
NIAGARA FALLS, NEW YORK
Client



LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- SOLID WASTE MANAGEMENT UNIT (SWMU) OR AREA OF CONCERN (AOC)
- (120) CHLORIDE CONCENTRATION, mg/l
- 250 CHLORIDE ISOPLETH, mg/l

NOTES: 1) OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

* 2) INDICATES THAT THE CONCENTRATION IS THE AVERAGE BETWEEN 4 REPLICATES.

0 feet 600

SCALE

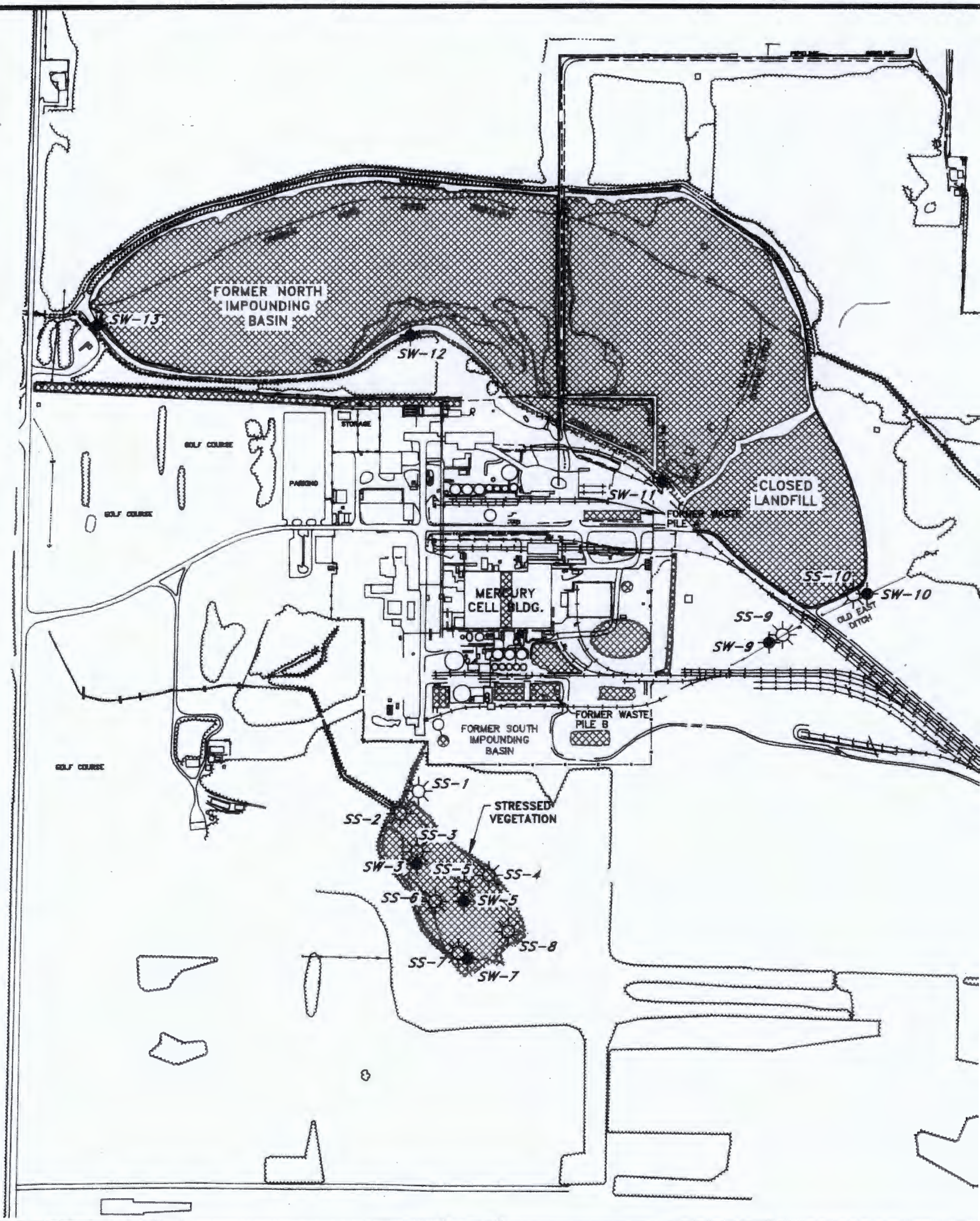
G&E ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

LOWER ZONE CHLORIDE CONCENTRATIONS ISOPLETHS APRIL 1992

3-19
Fig. No.

DRAWN BY	L.M.PITRE 6-22-92	CHECKED BY	APPROVED BY	DRAWING NO. 87-0188-B164



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NIAGARA FALLS, NEW YORK

Client

LEGEND

- SURFACE WATER SAMPLING LOCATION (SW)
- SURFACE SOIL SAMPLING LOCATION (SS)

NOTE: OW–2, OW–4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW–17, OW–18, OW–35, OW–42 AND OW–43 NOT USED.

0 feet 600
SCALE

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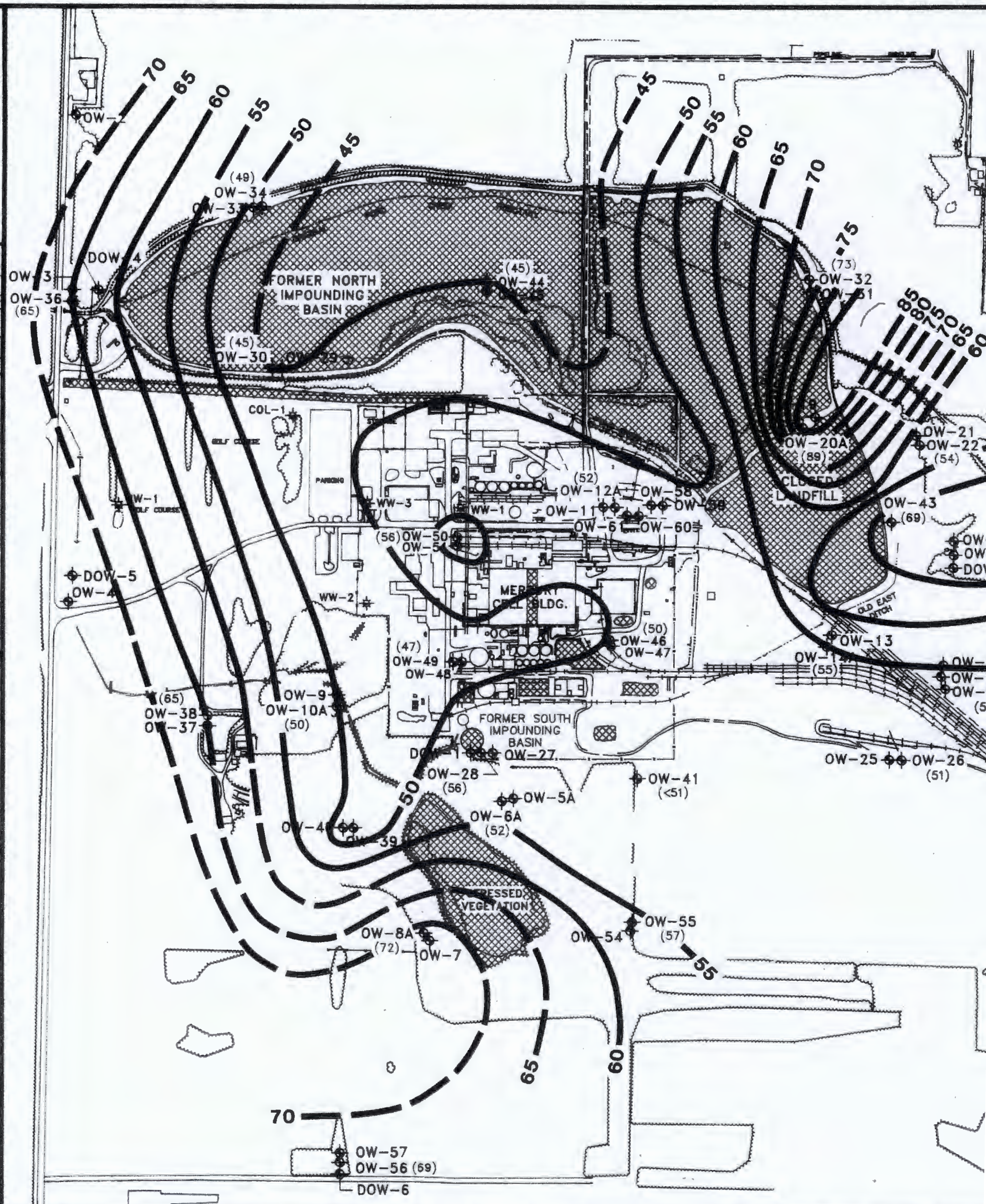
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

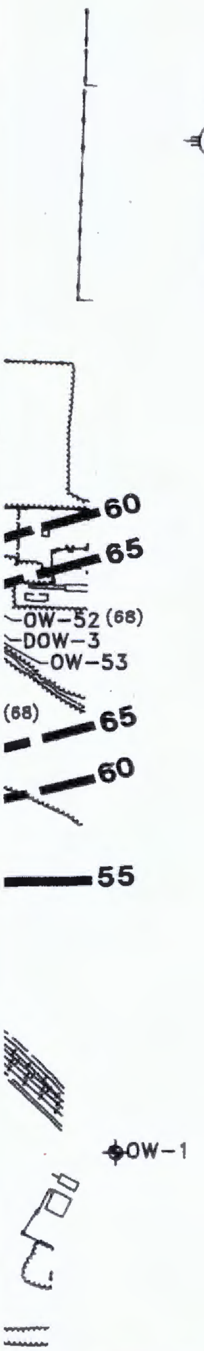
SURFACE WATER AND SOIL SAMPLING LOCATIONS

3-20
Fig. No.

DRAWING NO.	87-0188-B165
CHECKED BY	
APPROVED BY	
DRAWN BY	L.M.PITRE 5-20-92



DATE	NO.	REVISION	BY	OCCIDENTAL CHEMICAL CORPORATI
				NIAGARA FALLS, NEW YORK
				Client



LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- SOLID WASTE MANAGEMENT UNIT (SWMU) OR AREA OF CONCERN (AOC)
- (68) CLAY THICKNESS, FT.
- 50 CLAY THICKNESS CONTOUR, FT.

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

0 feet 600

SCALE

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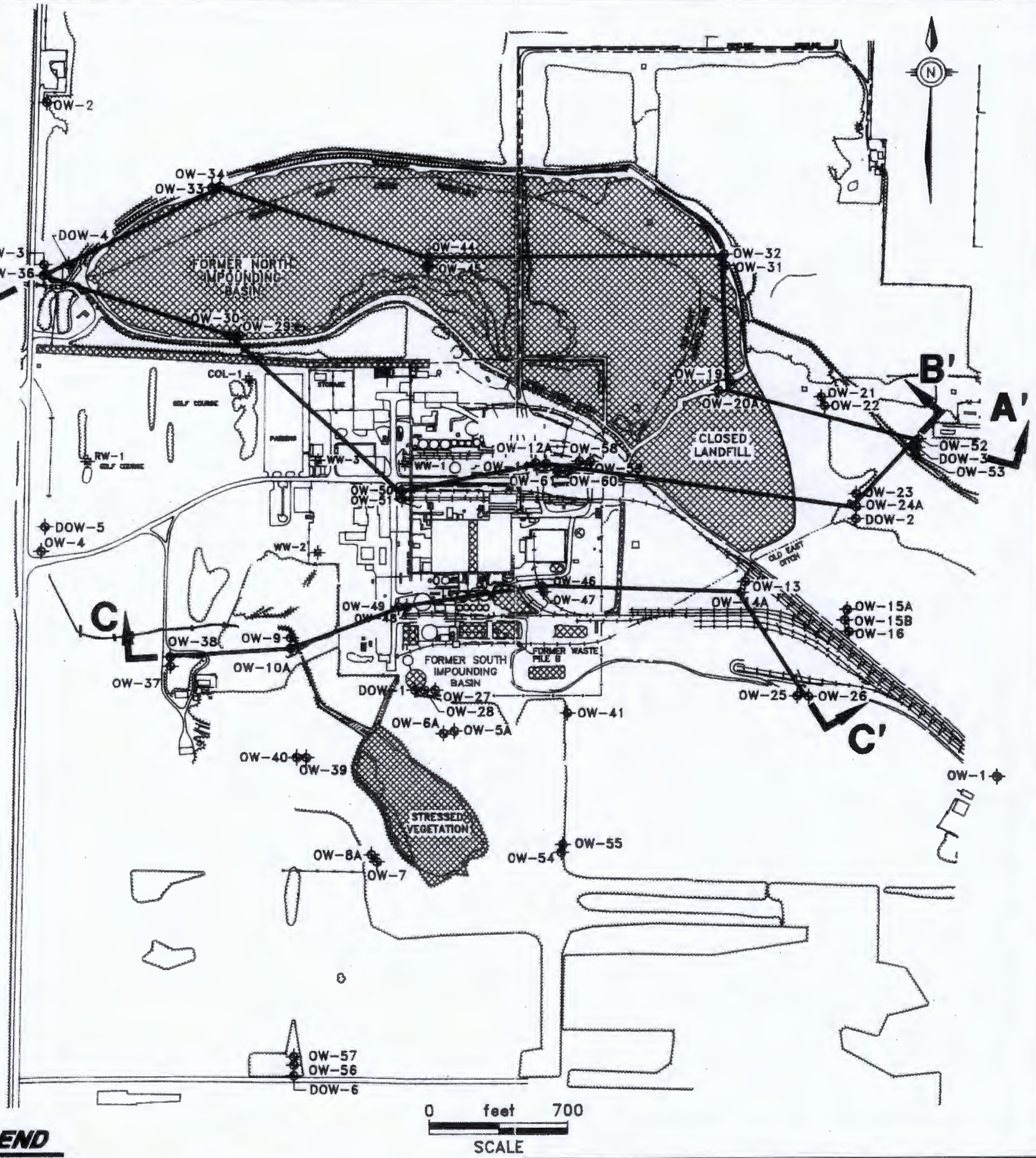
MUSCLE SHOALS, ALABAMA
Project Title

CLAY THICKNESS ISOPACHS

4-1
Fig. No.



LEGEND

- SILTY CLAY
- SILTY CLAY W/CHERT
- LIMESTONE
- LIMESTONE W/CHERT
- CHERT W/CLAY

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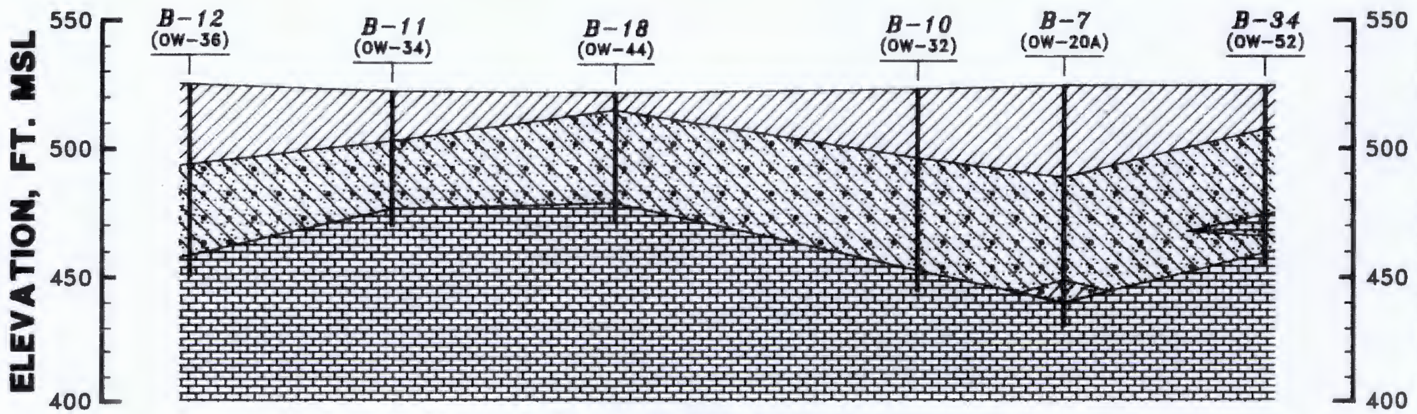
OCCIDENTAL CHEMICAL
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

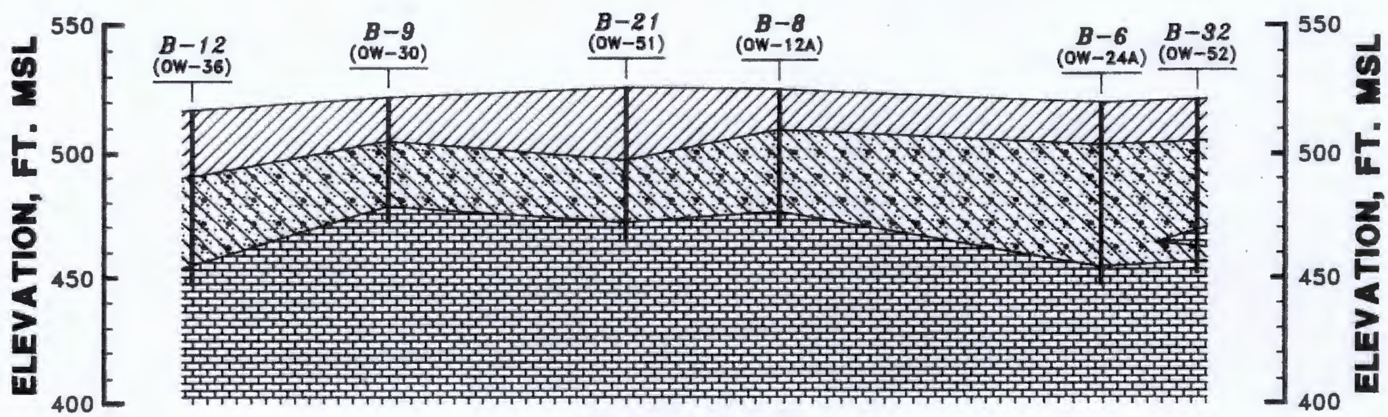
EAST TO WEST
GEOLOGIC CROSS-SECTION

4-2
Fig. No.

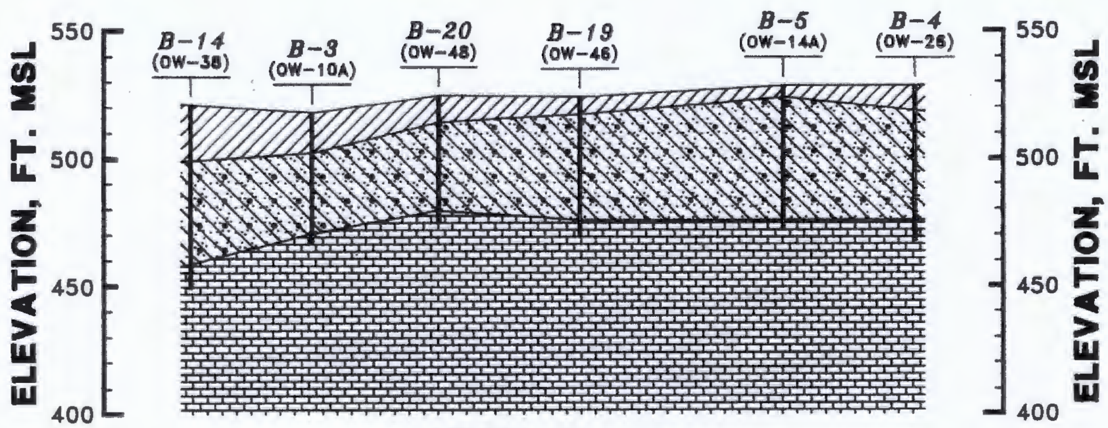
DRAWN BY L. T. OUBRE 6-11-92
CHECKED BY
APPROVED BY
DRAWING NO. 87-0188-B158



SECTION A-A'



SECTION B-B'



SECTION C-C'

DATE	NO.	REVISION	BY

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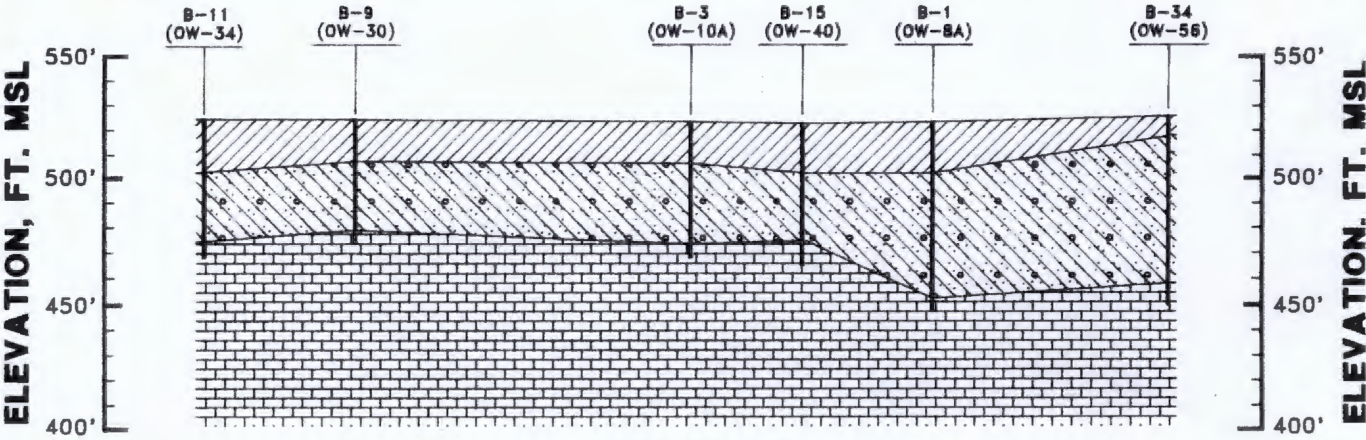
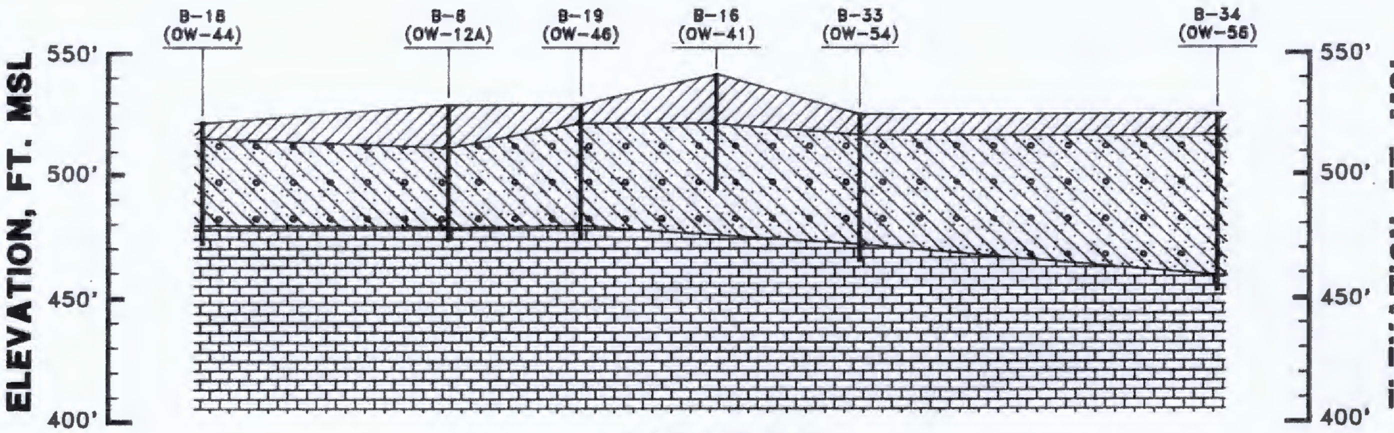
NIAGARA FALLS, NEW YORK

Client

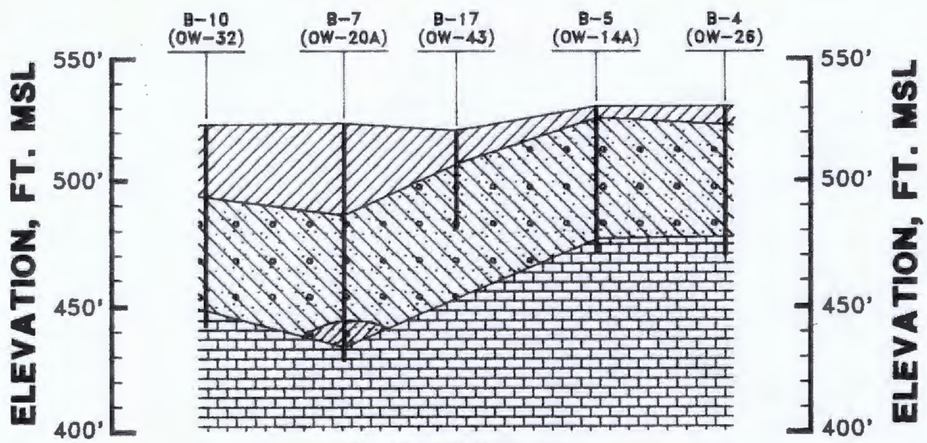
DRAWN BY L. T. OUBRE 6-11-92
CHECKED BY 6/25/92
APPROVED BY 6/25/92
DRAWING NO. 87-0188-B159



SECTION D-D'



SECTION E-E'



SECTION F-F'

DATE	NO.	REVISION	BY

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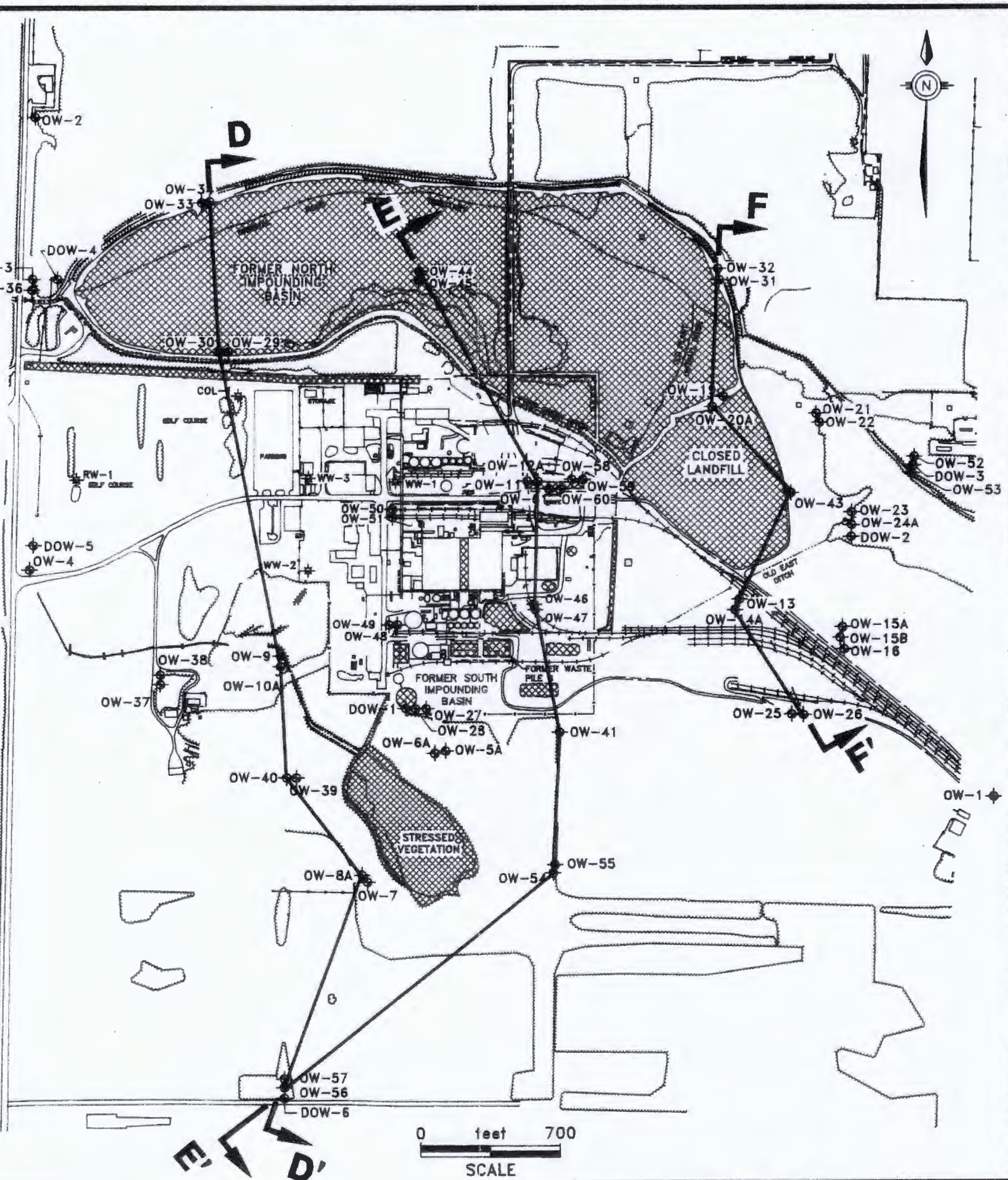
NIAGARA FALLS, NEW YORK
Client



LEGEND

CLAY	CHERT W/CLAY
CLAY W/CHERT	LIMESTONE

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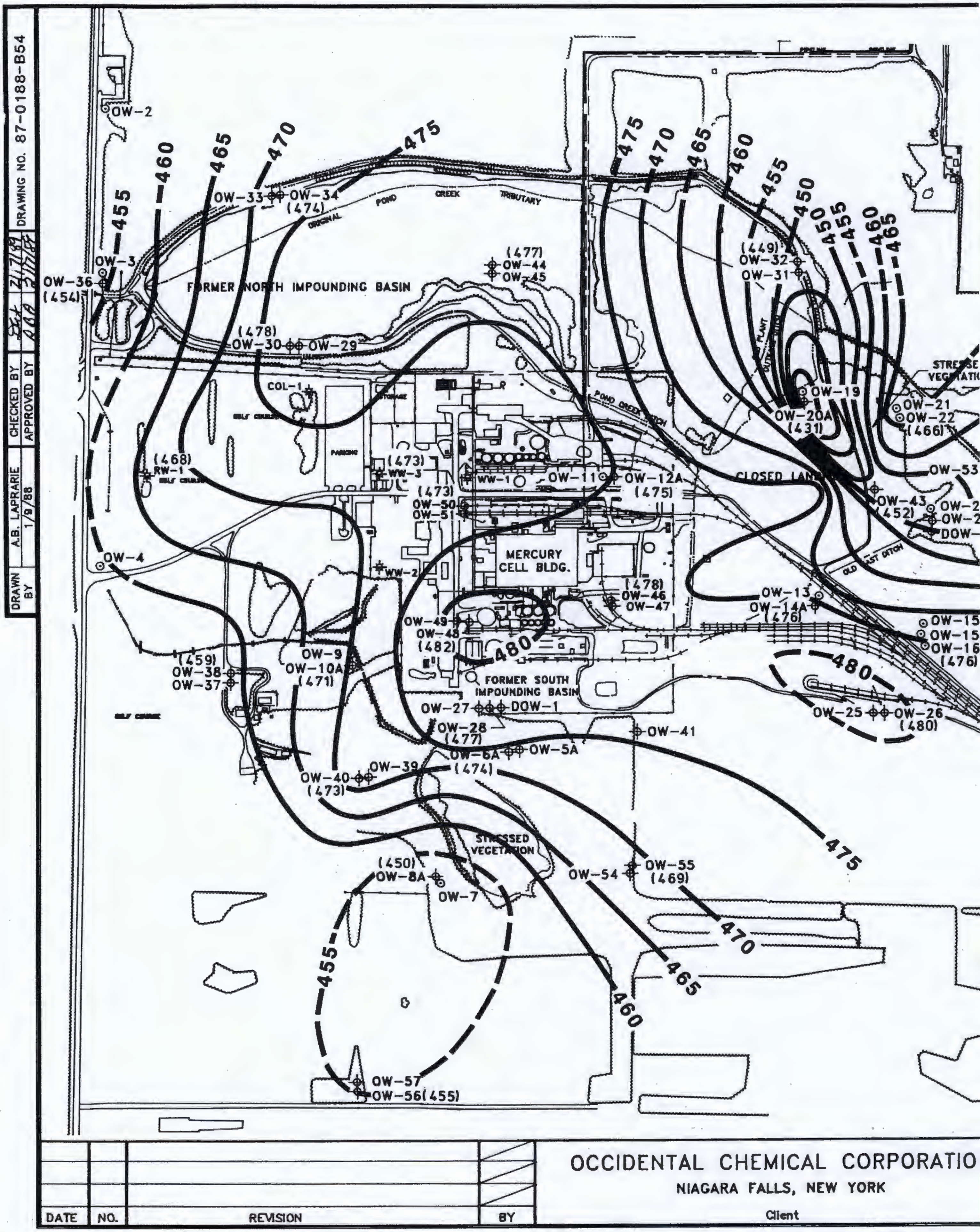
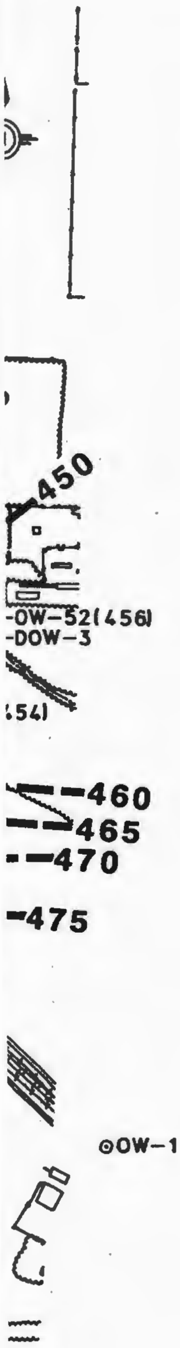
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

NORTH TO SOUTH
GEOLOGIC CROSS-SECTIONS

4-3
Fig. No.


DRAWING NO. 87-0188-B54
DRAWN BY A.B. LAPRARIE 1/9/88
CHECKED BY
APPROVED BY
FORMER NORTH IMPOUNDING BASIN
ORIGINAL POND CREEK TRIBUTARY
POND CREEK DITCH
MERCURY CELL BLDG.
FORMER SOUTH IMPOUNDING BASIN
STRESSED VEGETATION
CLOSED LANDFILL
OLD EAST DITCH
COL-1
PARKING
STORAGE
OW-2
OW-3
OW-36 (454)
OW-33 OW-34 (474)
(477) OW-44 OW-45
(478) OW-30 OW-29
(468) RW-1
(473) WW-3
WW-1 OW-11 OW-12A (475)
(473) OW-50 OW-51
WW-2
OW-4
(478) OW-46 OW-47
OW-49 OW-48 (482)
(459) OW-38 OW-37
OW-9 OW-10A (471)
OW-27 DOW-1
OW-28 (477)
OW-41
OW-6A OW-5A (474)
OW-40 (473) OW-39
(450) OW-8A OW-7
OW-54
OW-55 (469)
OW-57
OW-56 (455)
(449) OW-32
OW-31
OW-19
OW-20A (431)
OW-21
OW-22 (466)
OW-53
OW-43 (452)
OW-13
OW-14A (476)
OW-15
OW-16 (476)
OW-25 OW-26 (480)
455
460
465
470
475
480
450
DATE
NO.
REVISION
BY
OCCIDENTAL CHEMICAL CORPORATIO
NIAGARA FALLS, NEW YORK
Client



LEGEND

⊙	EXISTING MONITORING WELL (UPGRADED)
⌖	NEW MONITOR WELL
✢	WATER WELL (ABANDONED/CLOSED)
(454)	LIMESTONE ELEVATION, FT. MSL
—480—	LIMESTONE ELEVATION CONTOUR, FT. MSL

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35 AND OW-42 NOT USED.

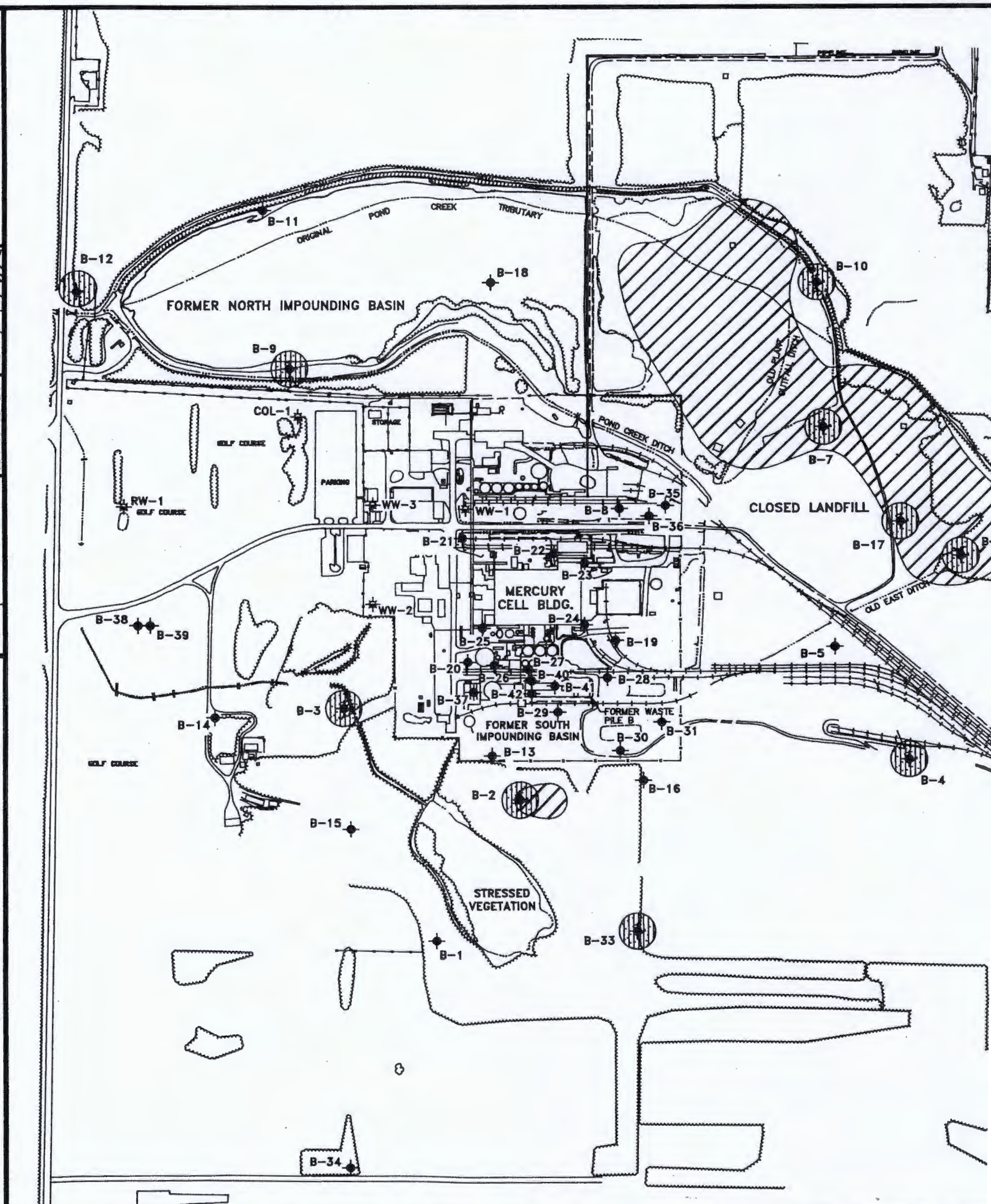
0 feet 600
SCALE

G&E ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS
Baton Rouge, Louisiana

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

LIMESTONE ELEVATIONS

4-4
Fig. No.



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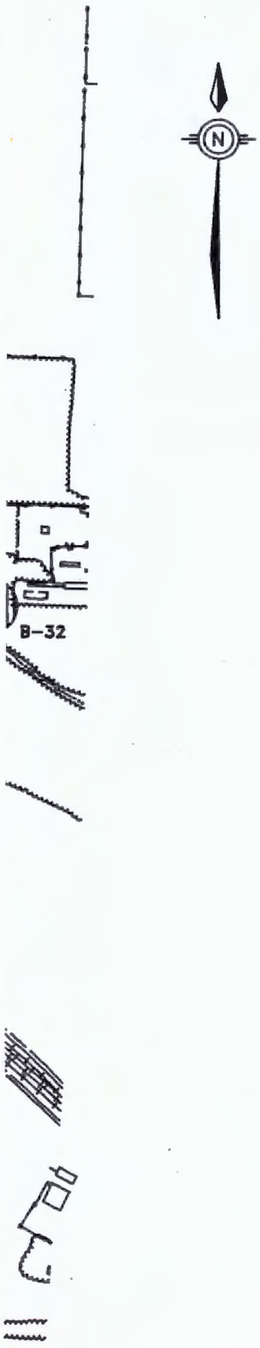
DRAWN BY	L.M.PITRE	6-9-92
CHECKED BY		6/25/92
APPROVED BY		6/25/92
DRAWING NO.	87-0188-B4	



LEGEND

- SOIL BORING LOCATION
- LIMESTONE VOIDS AND FRACTURES INFERRED FROM GEOPHYSICAL SURVEY
- LIMESTONE VOIDS AND FRACTURED INDICATED BY SOIL INVESTIGATION BORINGS (LESS THAN 80% LIMESTONE RECOVERY AND/OR LOSS OF DRILLING RECIRCULATION FLUID).

0 feet 600
SCALE

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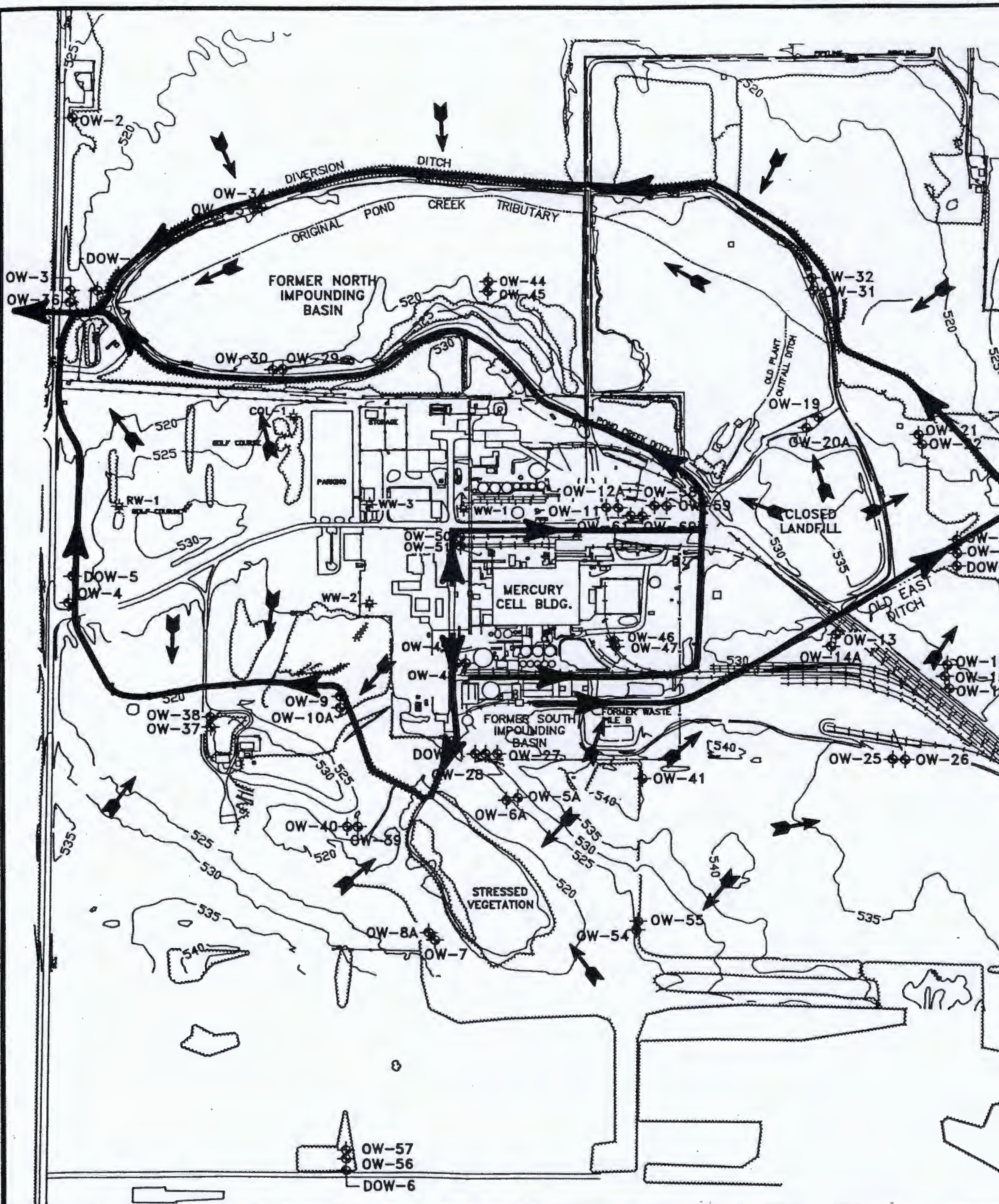
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

FRACTURED BEDROCK ZONE

4-5
Fig. No.

DRAWN BY	L.M.PITRE	6-17-92
CHECKED BY		9/25/92
APPROVED BY		9/25/92
DRAWING NO.	87-0188-B202	



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NOTE: RAINFALL RUNOFF AND SURFACE DRAINAGE WITHIN PLANT PROPERTY IS COLLECTED BY ASPHALT SURFACED DRAINAGE DITCHES WHICH PARALLEL THE YARD ROADS. THE FIGURE SHOWS THE MAIN DITCHES.

LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- DITCH
- SURFACE DRAINAGE DIRECTION

NOTES: 1) OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

0 feet 600
SCALE

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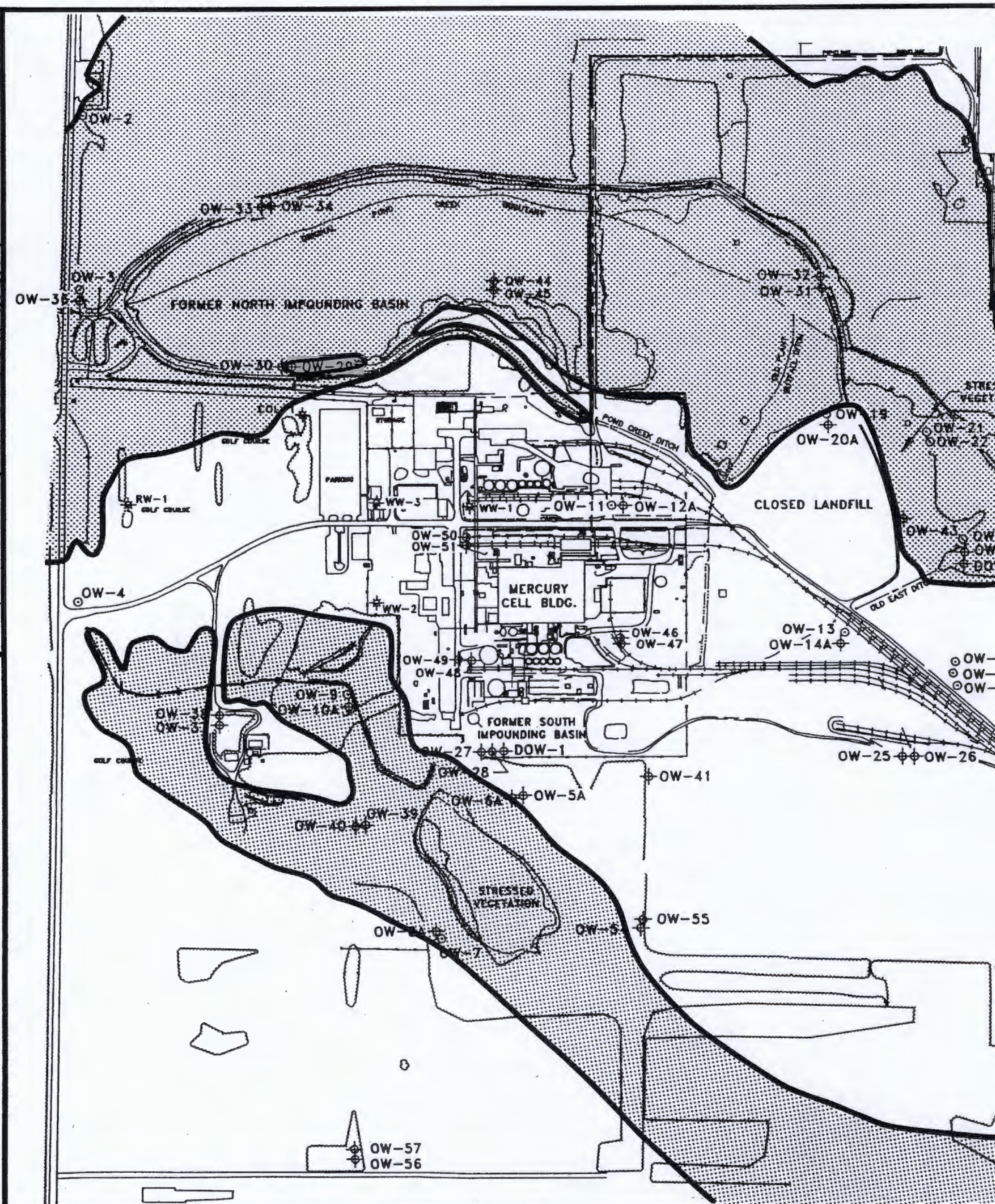
OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**SURFACE DRAINAGE PATTERN**	4-6 Fig. No.

DRAWING NO. 87-0188-B57

DRAWN BY	L.M. PITRE	1-9-88
CHECKED BY / APPROVED BY		6/25/92



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LEGEND

- ⊙ EXISTING MONITORING WELL (UPGRADED)
- NEW MONITOR WELL
- WATER WELL (ABANDONED/CLOSED)
- AREAS AFFECTED BY 100 YEAR FLOOD

NOTE:
1) THIS 100-YEAR FLOOD PLAIN WAS DRAWN FROM INFORMATION ON FLOOD INSURANCE RATE MAP FOR THE CITY OF MUSCLE SHOALS, COLBERT COUNTY, ALABAMA DATED DECEMBER 15, 1977.
2) 100-YEAR FLOOD ELEVATION IS 523 FT. (MSL)
3) OW-2, OW-4 AND ODD NUMBERD WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NO. OW-17, OW-18, OW-35 AND OW-42 NOT USED

0 feet 600
SCALE

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MUSCLE SHOALS, ALABAMA
Project Title

100-YEAR FLOOD PLAIN

4-7
Fig. No.

Figure 18.–Piezometric map of Lauderdale and Colbert Counties, M

RE: GEOLOGICAL SURVEY OF ALABAMA, ATLAS SERIES 6 1974, PAGE No. 25.

DRAWN BY	L.M. PITRE 4-23-92	CHECKED BY	APPROVED BY	DRAWING NO.	87-0188-B15

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1958.

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OCCIDENTIAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**REGIONAL SHALLOW GROUNDWATER FLOW SYSTEM**	**4-8** Fig. No.

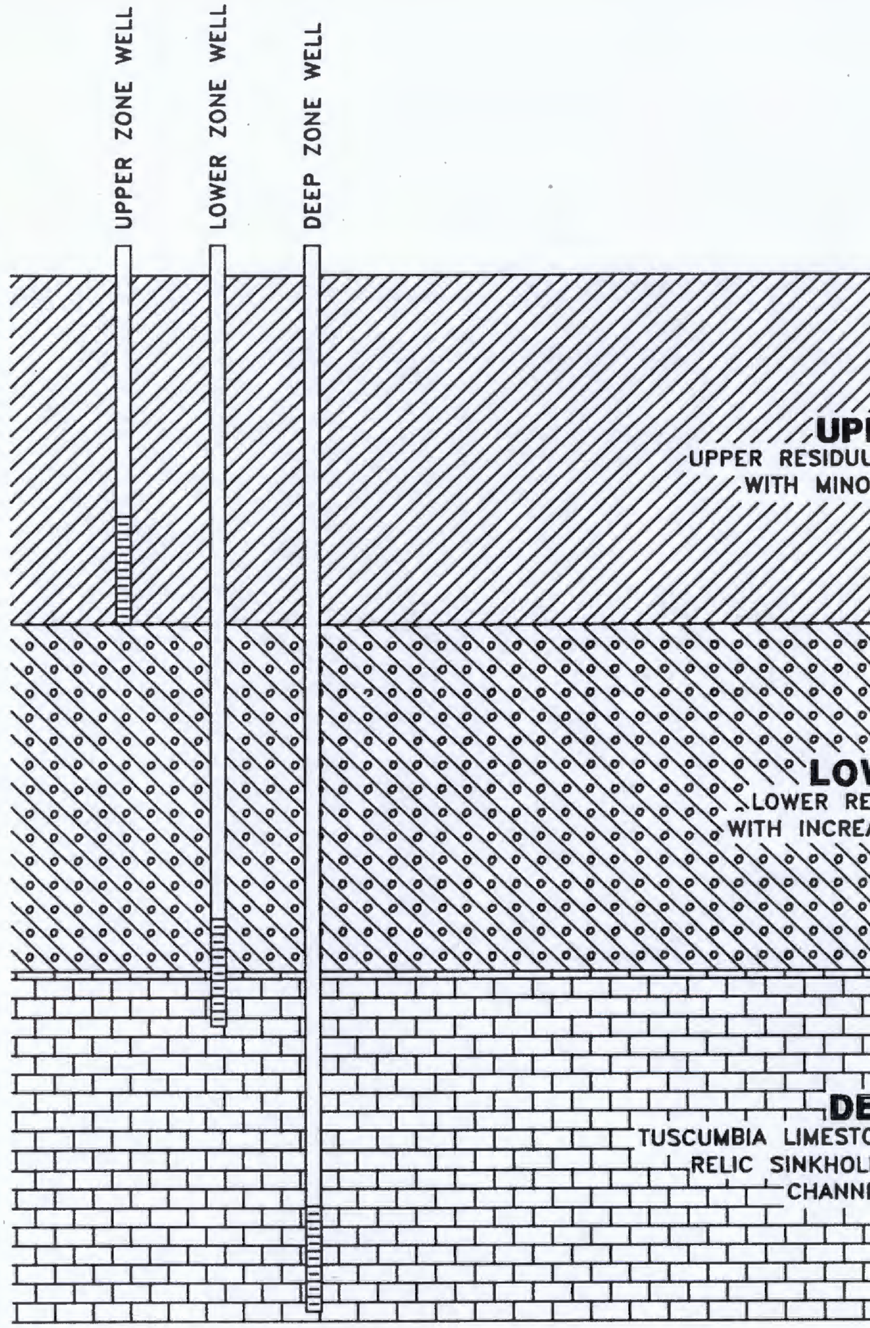
DRAWN BY	A.B. LAPRAIRIE	4-30-92
CHECKED BY		6/25/92
APPROVED BY		6/25/92
DRAWING NO.	87-0188-B176	

DIRECTION OF GROUNDWATER FLOW

RADIAL, AWAY FROM THE PLANT PROPER

RADIAL, AWAY FROM THE PLANT PROPER

FROM NORTHEAST TO SOUTHWEST



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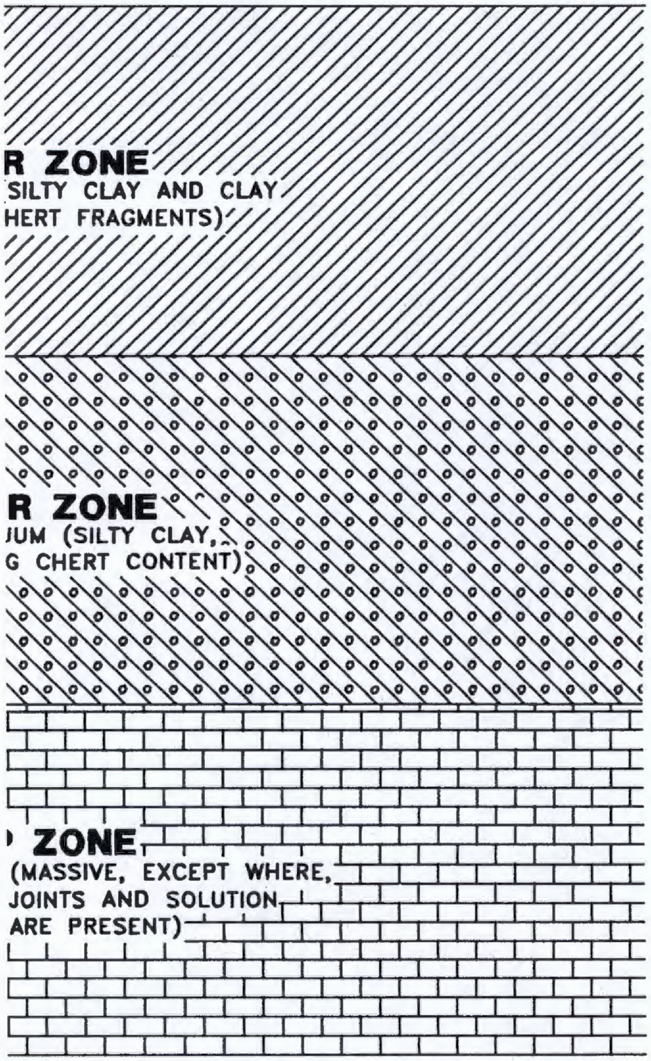

DEPTH	RANGE OF HYDRAULIC CONDUCTIVITY (k) (cm/sec)
0'	$1\times10^{-4} - 2\times10^{-5}$ (32 TESTS)
15' - 25'	$4\times10^{-3} - 5\times10^{-5}$ (26 TESTS)*
45' - 90'	$1.4\times10^{-3} - 8.2\times10^{-7}$ (6 TESTS)*

* IN-SITU HYDRAULIC CONDUCTIVITY SLUG TESTS IN 2 LOWER ZONE WELLS AND 2 DEEP ZONE WELLS REVEALED NEAR INSTANTANEOUS REBOUND, SUGGESTING VERY HIGH HYDRAULIC CONDUCTIVITY VALUES.

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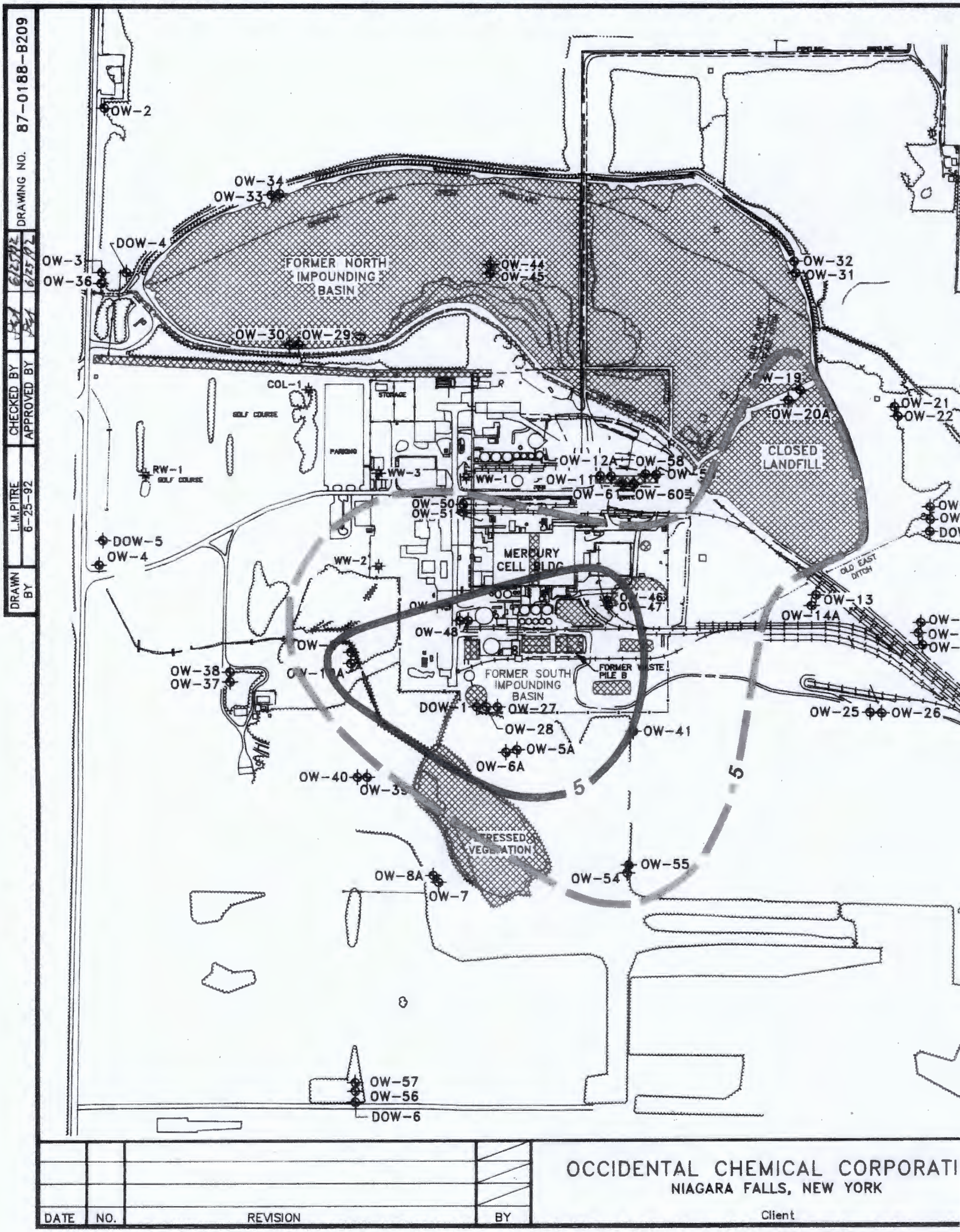
MUSCLE SHOALS, ALABAMA
Project Title

SIMPLIFIED HYDROGEOLOGIC PROFILE

4-9
Fig. No.


DRAWING NO. 87-0188-B209
DRAWN BY L.M.PITRE 6-25-92
CHECKED BY 6/25/92
APPROVED BY 6/25/92
FORMER NORTH IMPOUNDING BASIN
CLOSED LANDFILL
MERCURY CELL BLDG
FORMER SOUTH IMPOUNDING BASIN
FORMER WASTE PILE B
STRESSED VEGETATION
OLD EAST DITCH
GOLF COURSE
STORAGE
PARKING
OW-2
OW-34
OW-33
DOW-4
OW-3
OW-36
OW-44
OW-45
OW-32
OW-31
OW-30
OW-29
COL-1
OW-19
OW-20A
OW-21
OW-22
RW-1
WW-3
WW-1
OW-12A
OW-11
OW-58
OW-6
OW-60
OW-50
OW-51
DOW-5
OW-4
WW-2
OW-46
OW-47
OW-13
OW-14A
OW-48
OW-38
OW-37
DOW-1
OW-27
OW-28
OW-41
OW-5A
OW-6A
OW-25
OW-26
OW-40
5
OW-55
OW-54
OW-8A
OW-7
OW-57
OW-56
DOW-6
DATE
NO.
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BY
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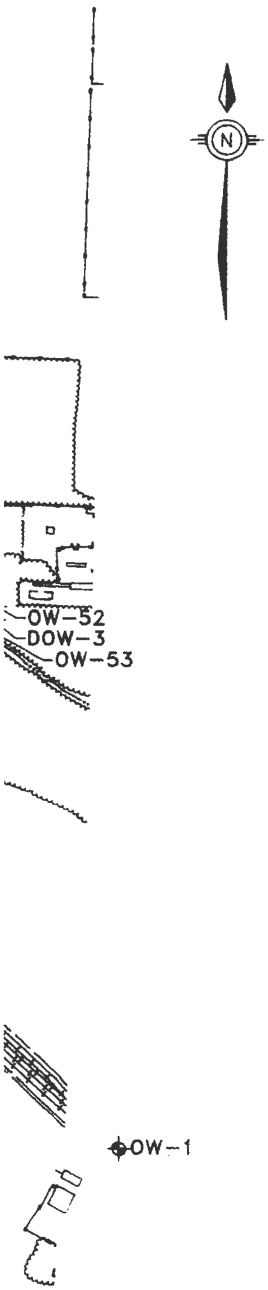

LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- SOLID WASTE MANAGEMENT UNIT (SWMU) OR AREA OF CONCERN (AOC)
- UPPER ZONE MERCURY PLUME BOUNDARY, mg/l
- LOWER ZONE MERCURY PLUME BOUNDARY, mg/l

NOTES: 1) OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

0 feet 600

SCALE

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MUSCLE SHOALS, ALABAMA

Project Title

UPPER AND LOWER ZONE MERCURY PLUME BOUNDARY

5-1

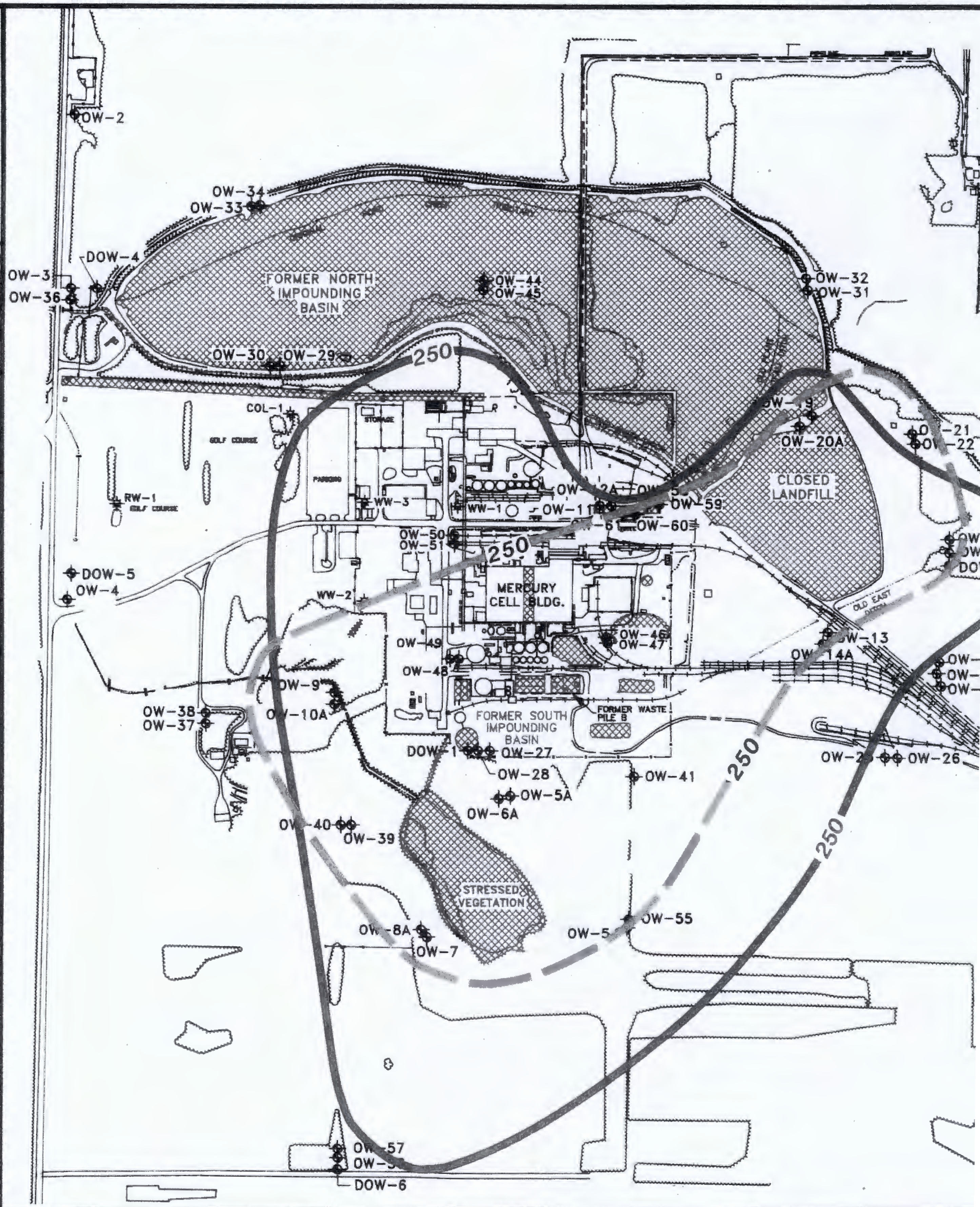
Fig. No.

DRAWING NO. 87-0188-B189

DRAWN BY A.B. LAPRARIE 6-25-92

CHECKED BY 6/25/92

APPROVED BY 6/25/92



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LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- SOLID WASTE MANAGEMENT UNIT (SWMU) OR AREA OF CONCERN (AOC)
- UPPER ZONE CHLORIDE PLUME BOUNDARY, mg/l
- LOWER ZONE CHLORIDE PLUME BOUNDARY, mg/l

NOTES: 1) OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

0 feet 500

SCALE

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CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

UPPER AND LOWER ZONE
CHLORIDE PLUME BOUNDARY

5-3
Fig. No.

DRAWN BY	L.M.PITRE	CHECKED BY		6/25/92	DRAWING NO. 87-0188-B210
	6-25-92	APPROVED BY		6/25/92	

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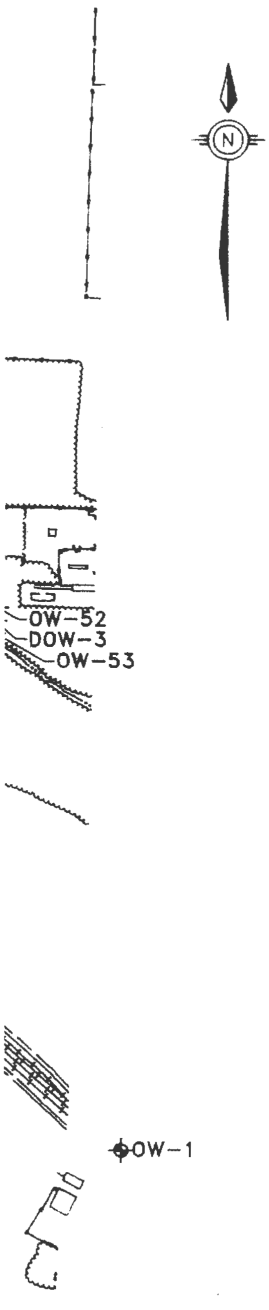

LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- SOLID WASTE MANAGEMENT UNIT (SWMU) OR AREA OF CONCERN (AOC)
- COMPOSITE UPPER & LOWER ZONE MERCURY PLUME, ug/l
- COMPOSITE UPPER & LOWER ZONE CADMIUM PLUME, ug/l
- COMPOSITE UPPER & LOWER ZONE CHLORIDE PLUME, mg/l

NOTES:
1) OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS. WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.
2) PLUMES ARE BASED ON MEAN CONCENTRATIONS (APRIL 1992)

0 feet 600
SCALE

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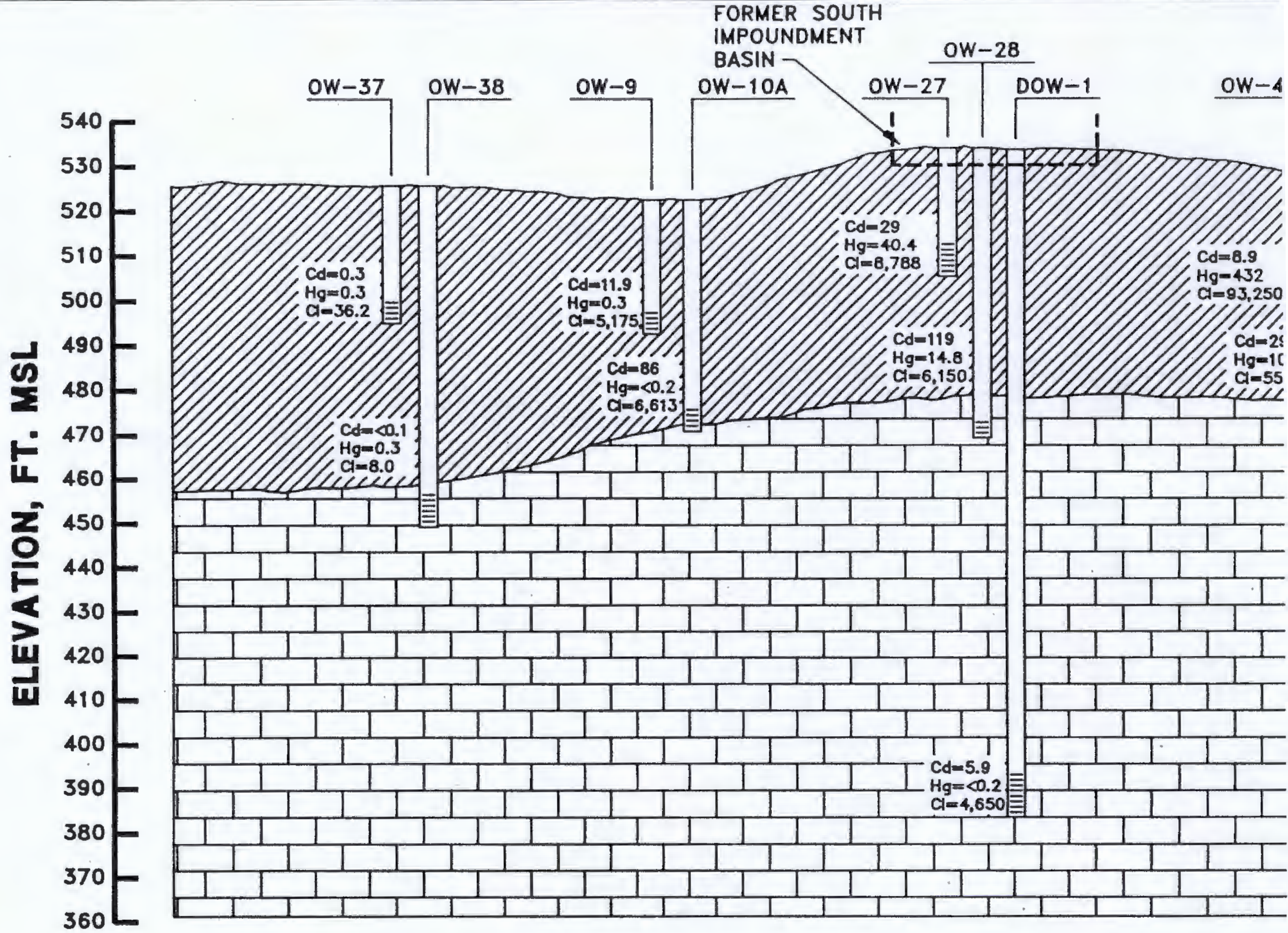
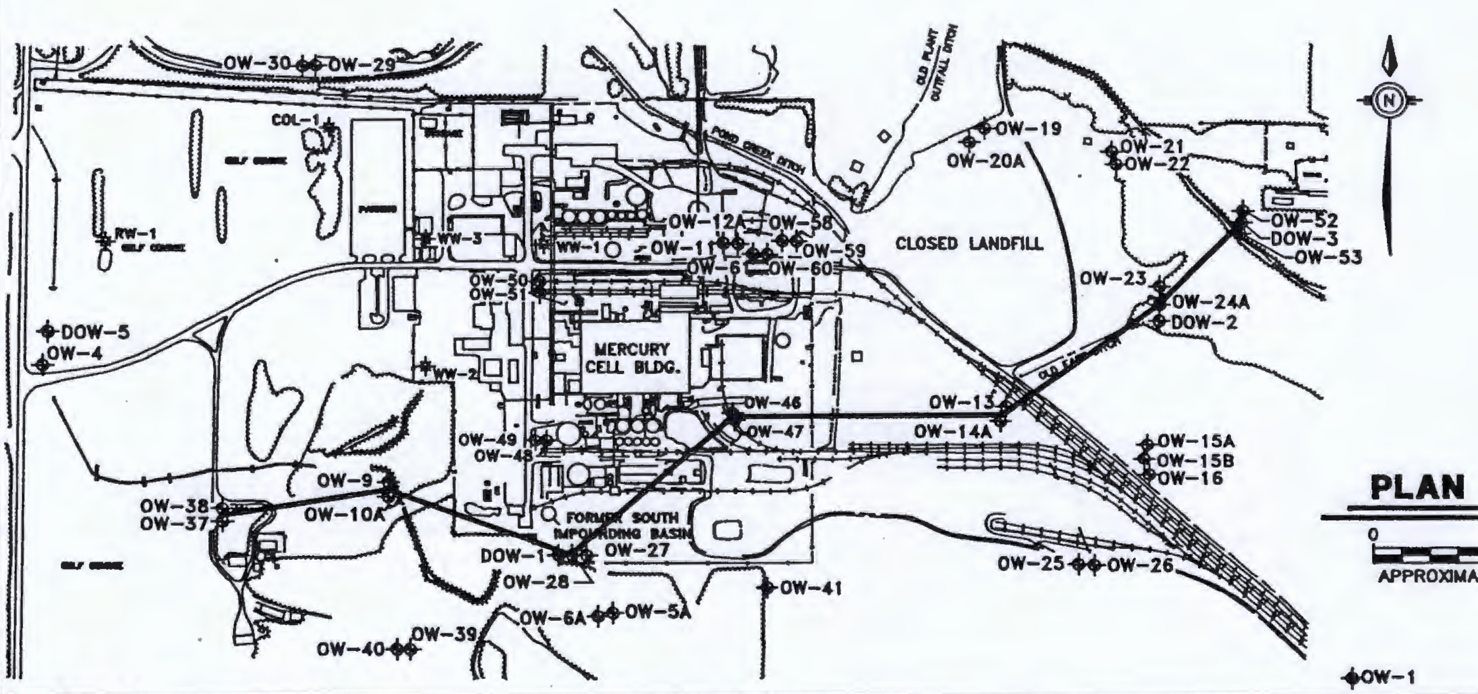
CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

MERCURY, CADMIUM, CHLORIDE COMPOSITE PLUMES

5-4
Fig. No.





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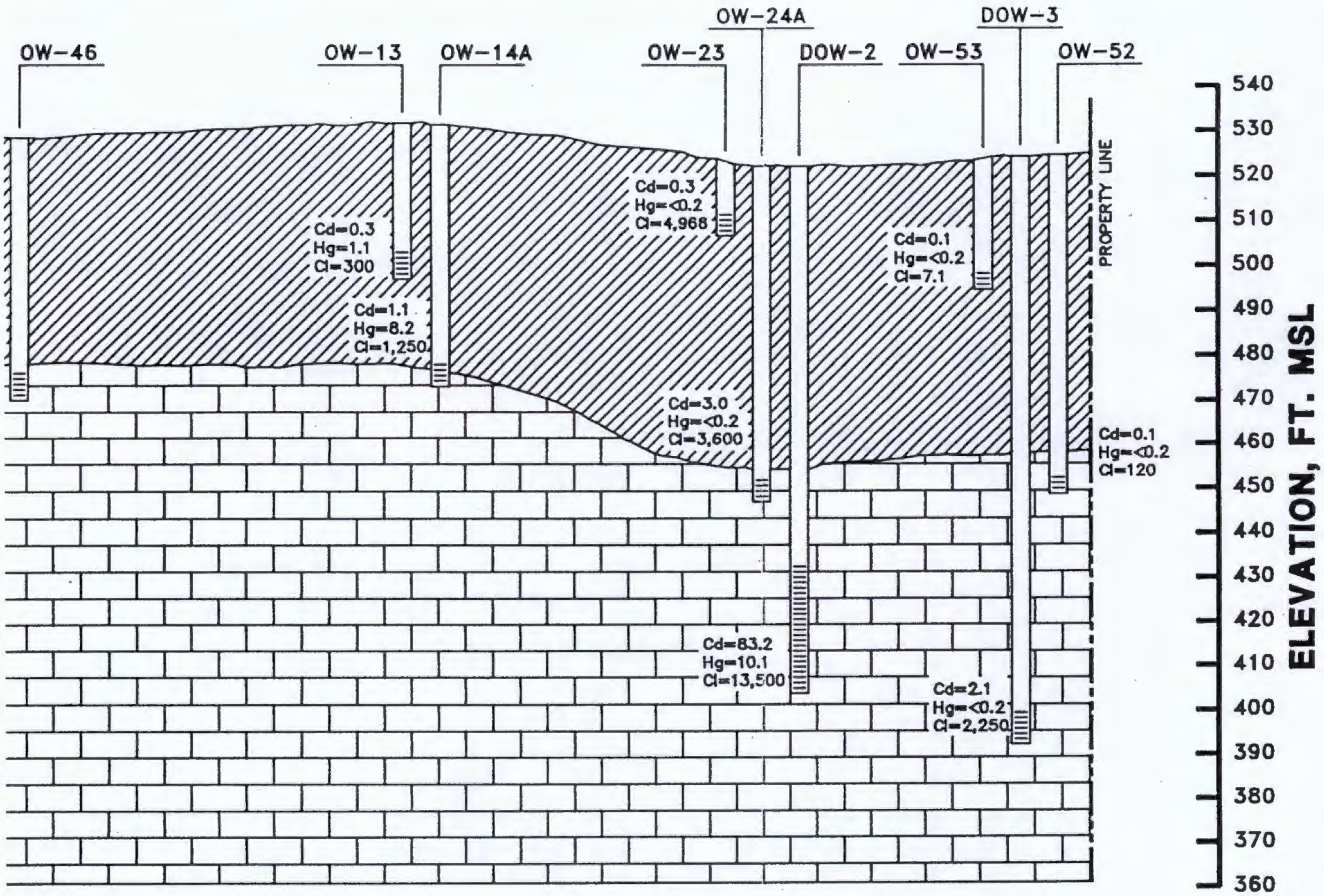
Client

DRAWN BY	L.M.PITRE 6-22-92	CHECKED BY / APPROVED BY	6/25/92 6/25/92	DRAWING NO.	87-0188-B203



LEGEND

REGOLITH (CLAY, CLAY/CHERT)

LIMESTONE

NOTES: 1) Cl IN ppm, Cd & Hg IN ppb.

2) CONCENTRATIONS ARE UNFILTERED (TOTAL) CONCENTRATIONS TAKEN APRIL 1992.

VERTICAL SCALE: 1" = 40'
HORIZONTAL SCALE: 1" = 500'

EW
700
CALE

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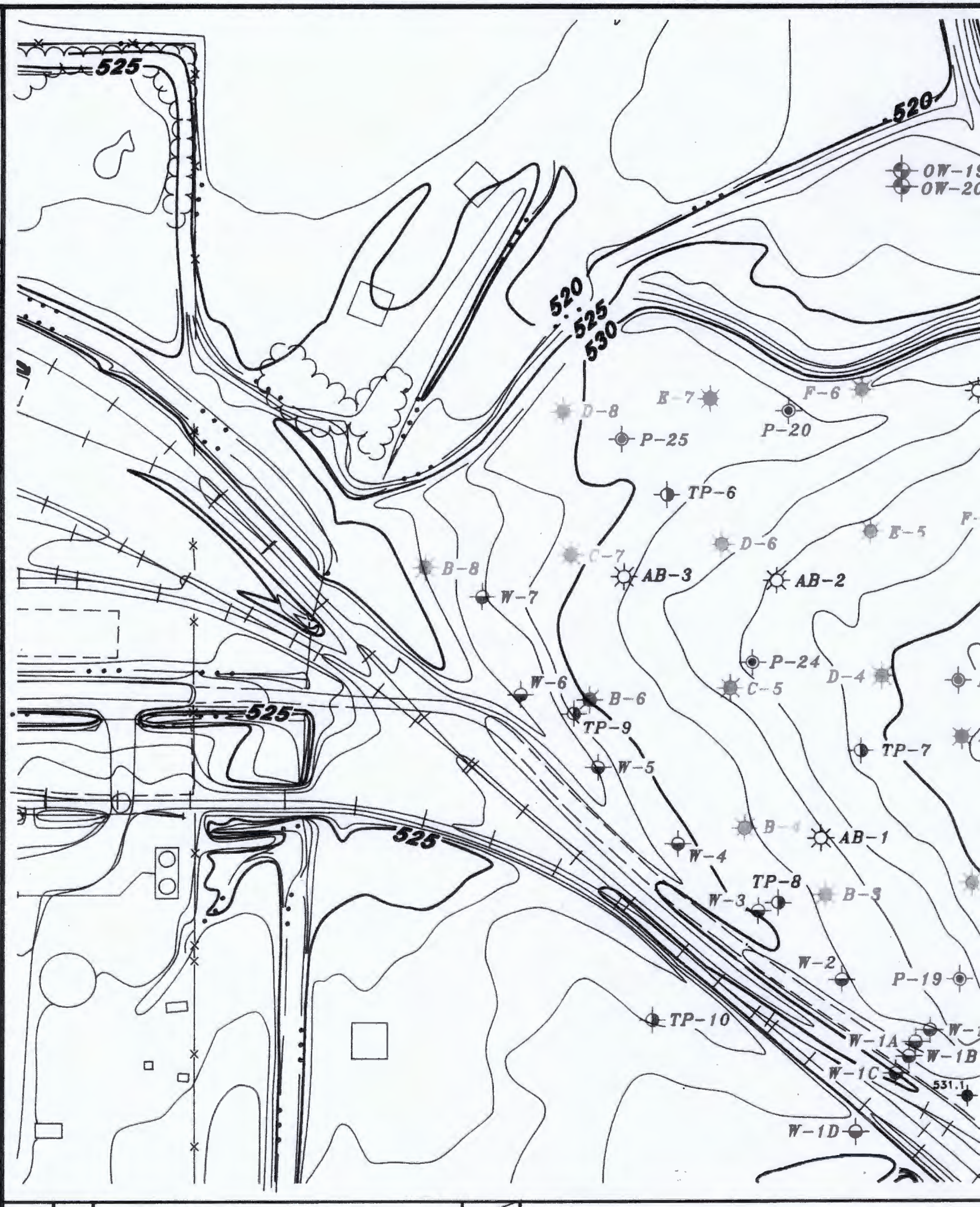
MUSCLE SHOALS, ALABAMA
Project Title

VERTICAL CROSS SECTION OF CADMIUM, MERCURY & CHLORIDE GROUNDWATER CONCENTRATIONS

5-5
Fig. No.

DRAWN BY	A.B. LAPRARIE	6-1-92
CHECKED BY		6/25/92
APPROVED BY		6/25/92
DRAWING NO.	87-0188-B190	



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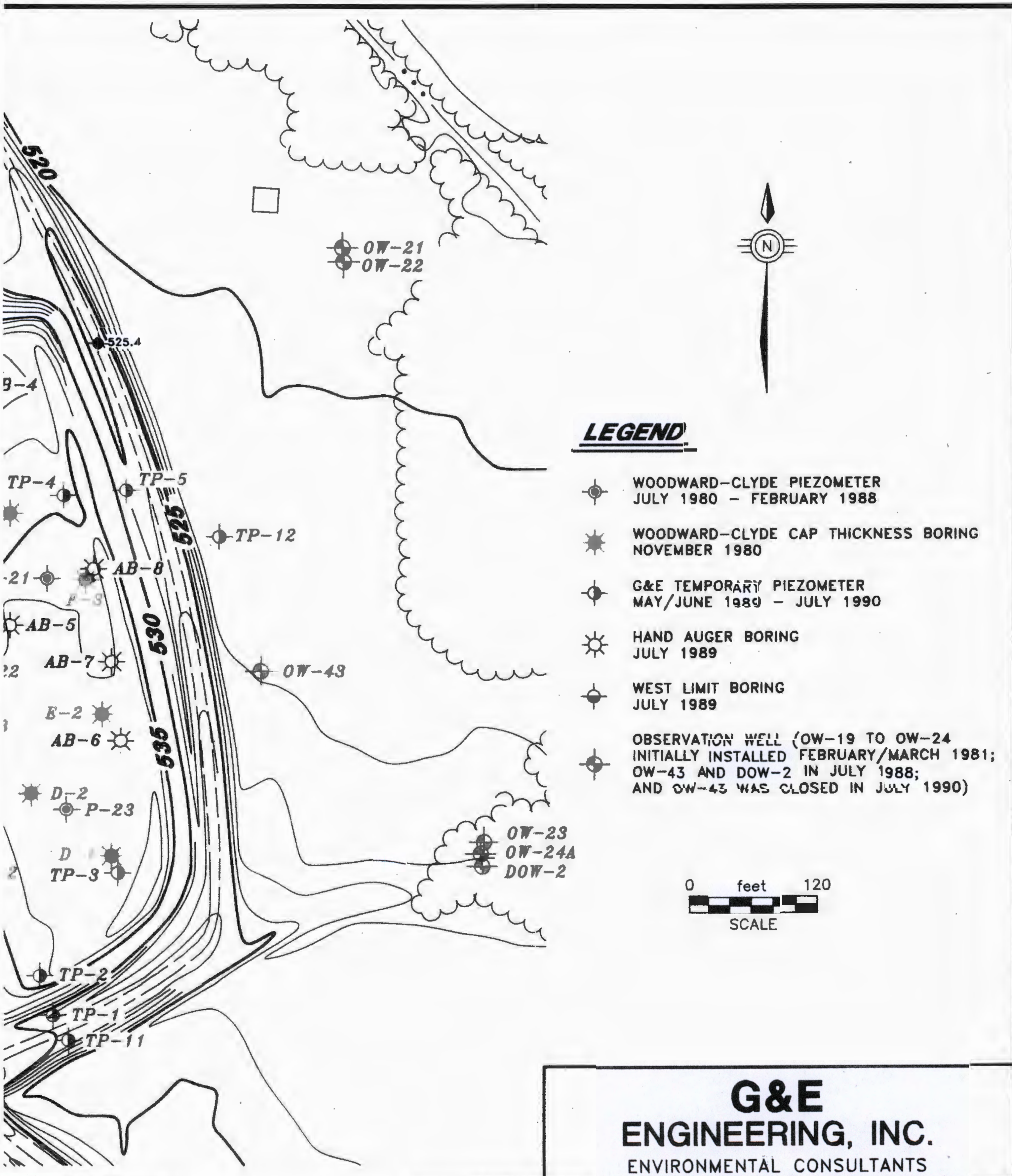

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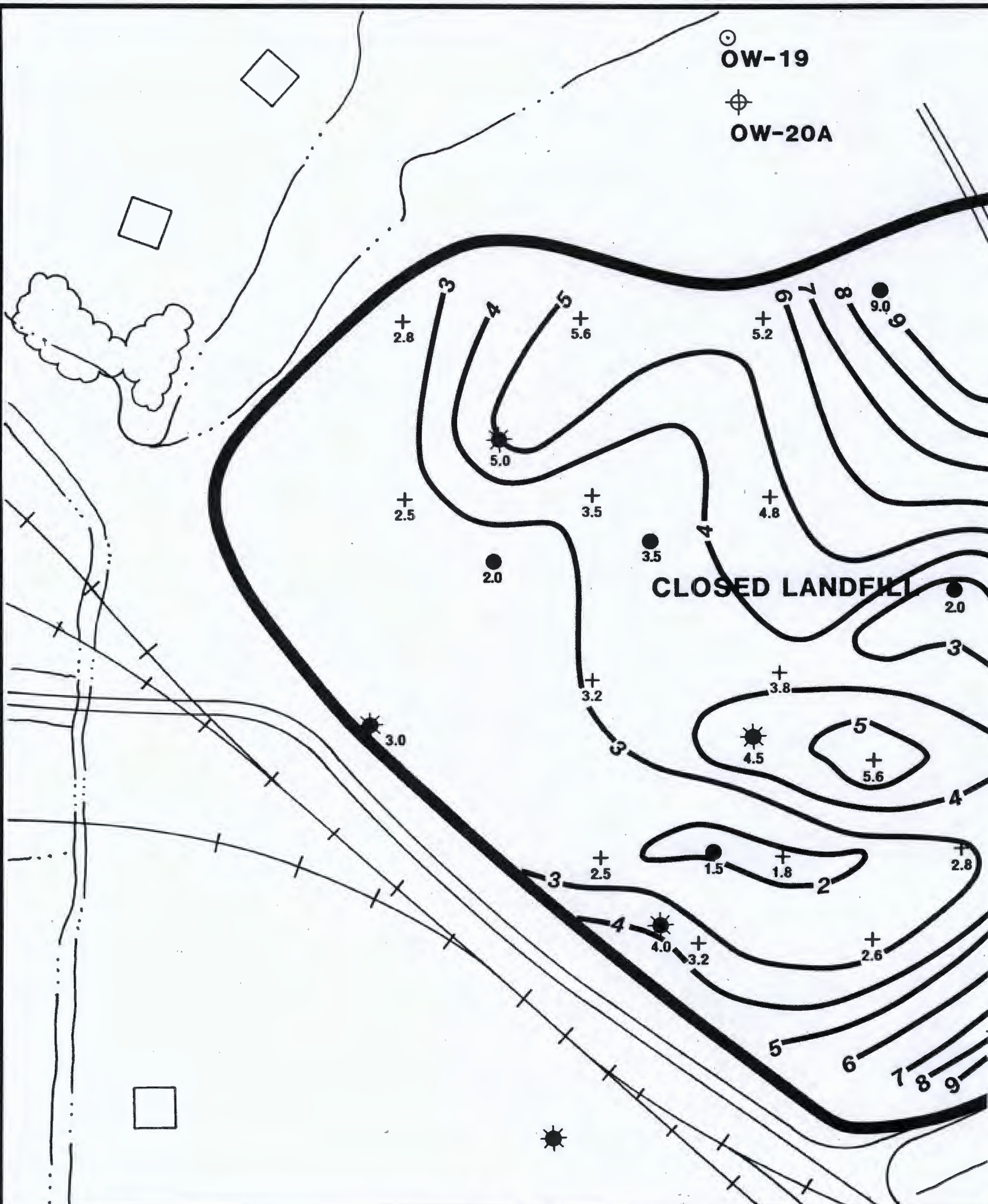
MUSCLE SHOALS, ALABAMA
Project Title

LOCATION OF PIEZOMETERS, HAND AUGER BORINGS AND OBSERVATION WELLS

8-1
Fig. No.



DRAWN BY S.C. SUTTON 7-10-89 | CHECKED BY 6/25/92 | APPROVED BY 6/25/92 | DRAWING NO. 87-0188-B68

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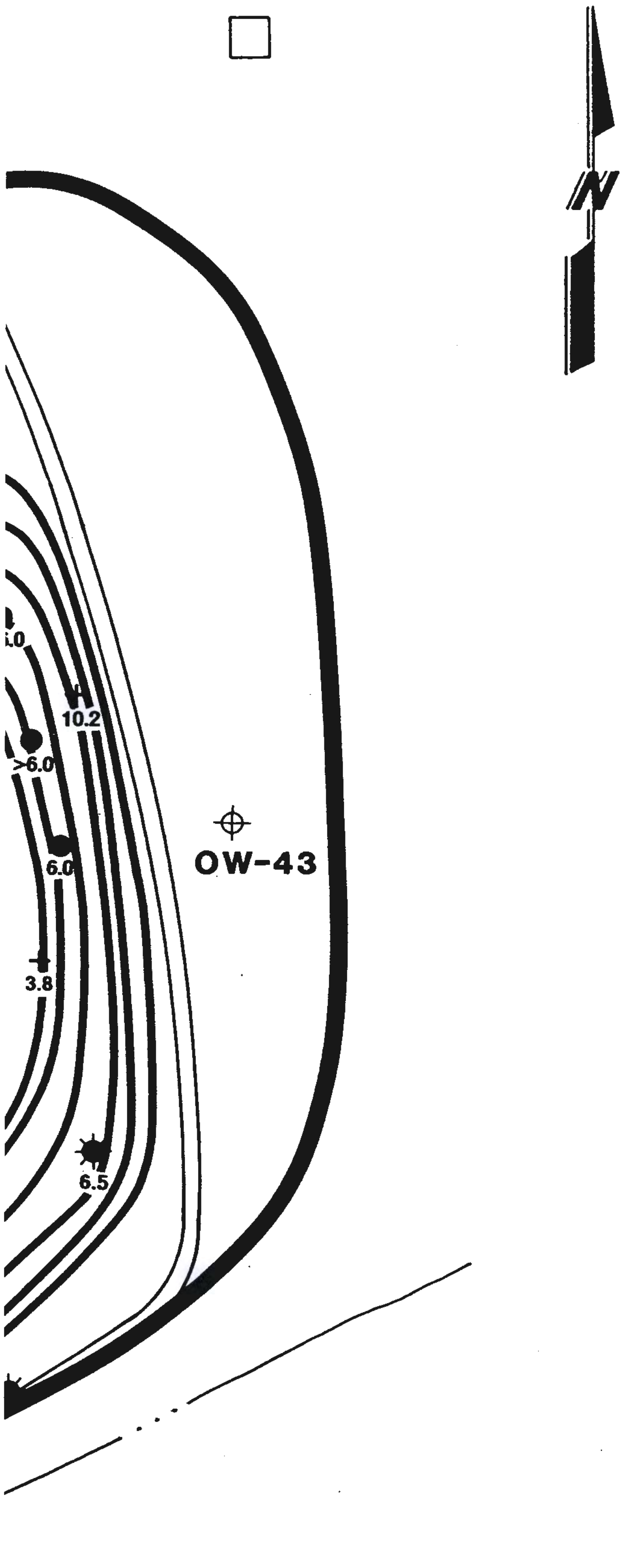
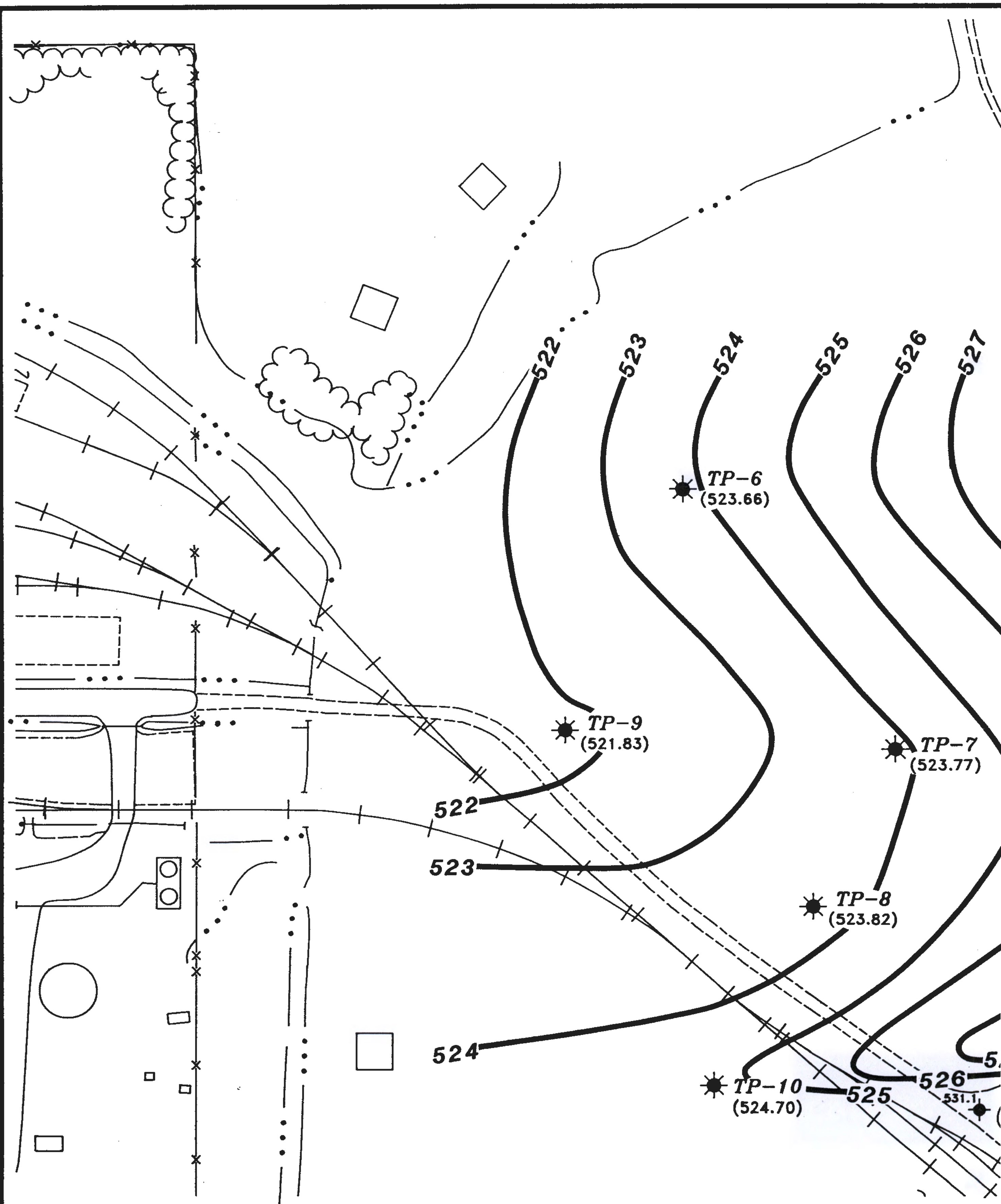


LEGEND

- EXISTING MONITORING WELL (UPGRADED)
- NEW MONITOR WELL
- WOODWARD-CLYDE CAP EVALUATION
- G&E TEMPORARY PIEZOMETER
- G&E HANDAUGER BORINGS
- —4— CLAY THICKNESS (FEET)

G&E ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS
Baton Rouge, Louisiana

Project Title		Fig. No.
OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA	ISOPACH MAP OF LANDFILL CAP	8-2



DRAWN BY	A.B. LAPRARIE 3-29-90	CHECKED BY / APPROVED BY		DRAWING NO. 87-0188-B67

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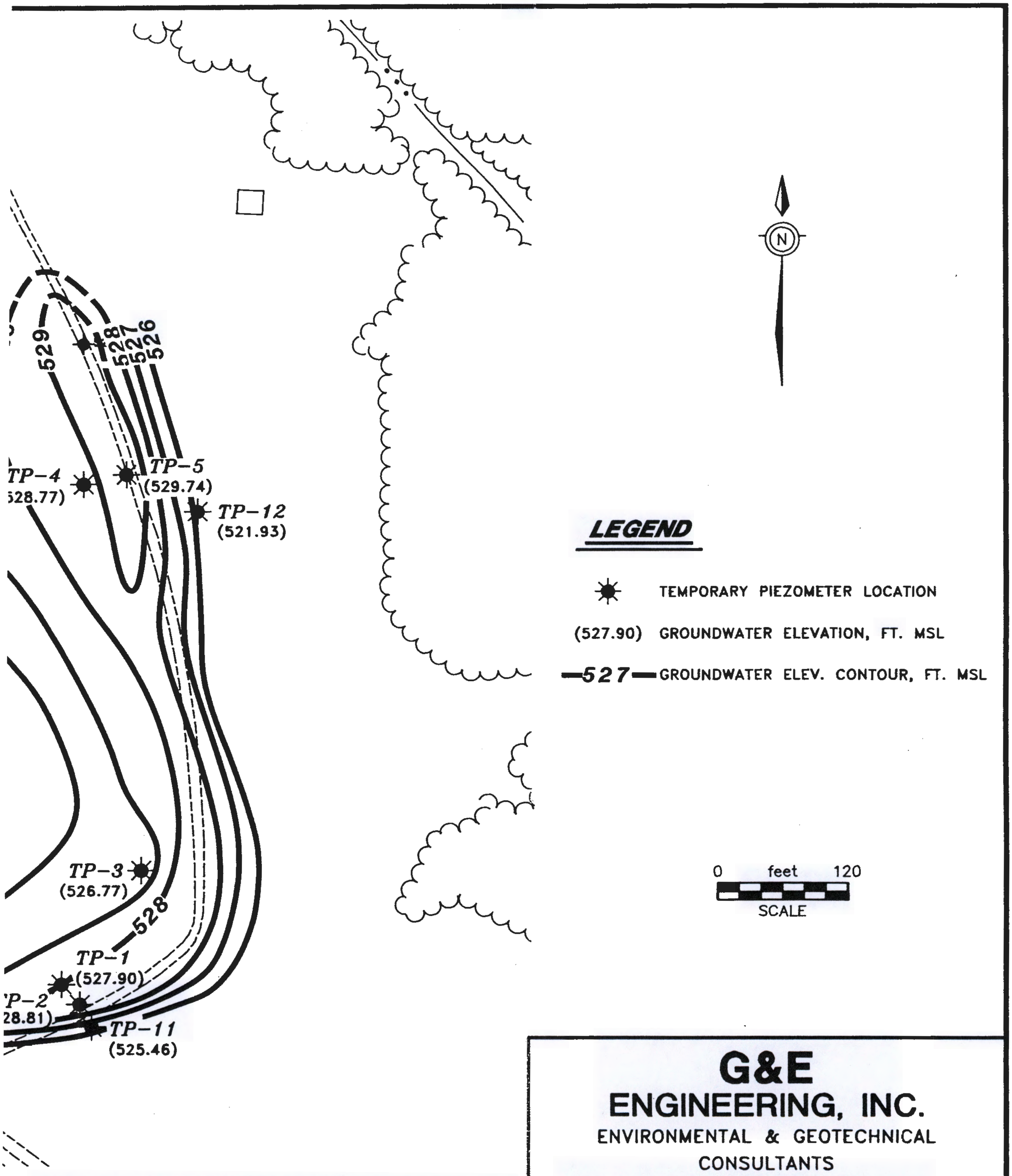

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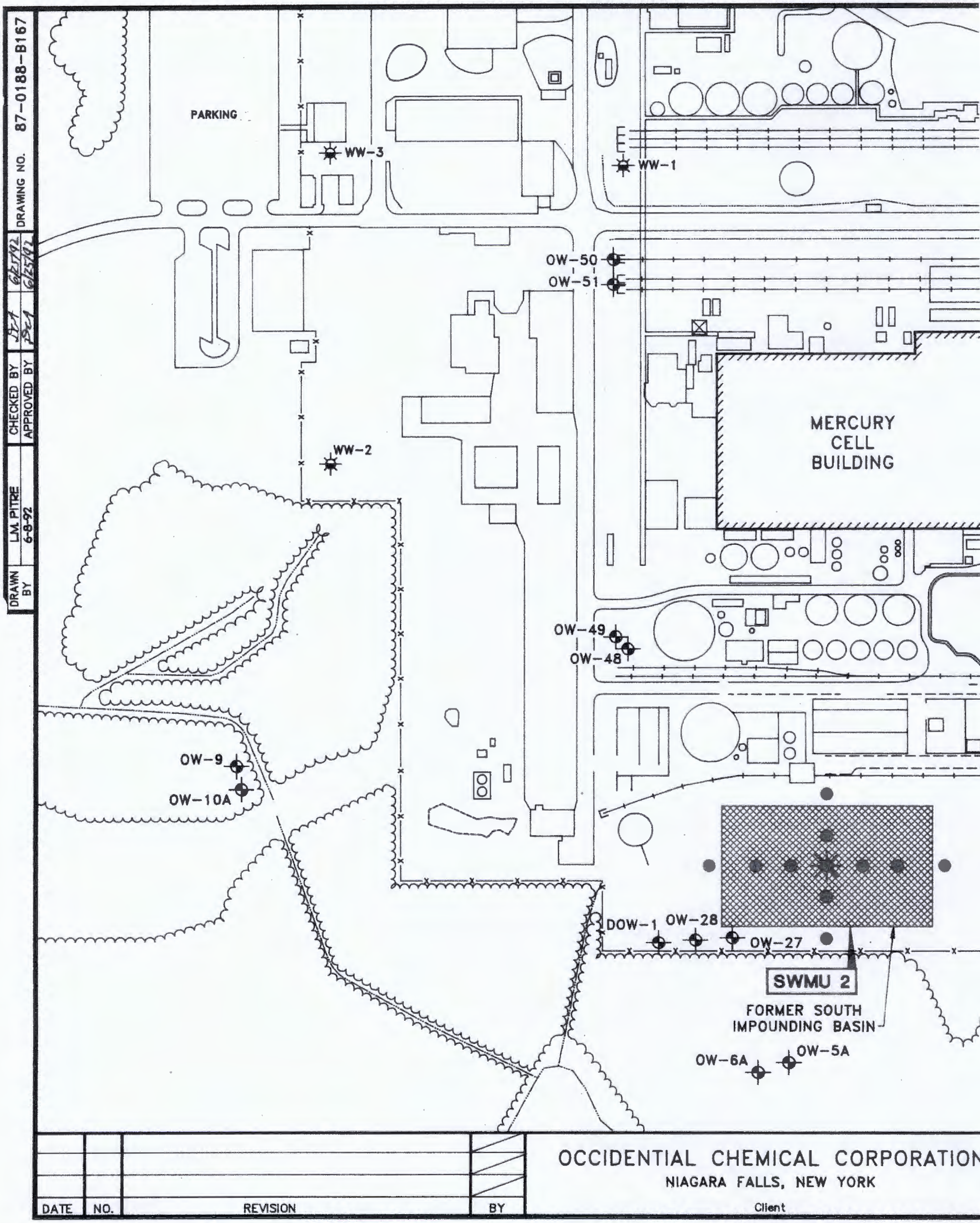
OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**LANDFILL AREA POTENTIOMETRIC CONTOUR MAP (MARCH 1990)**	**8-3** Fig. No.



DRAWING NO. 87-0188-B167
CHECKED BY
APPROVED BY
6/25/92
6/25/92
DRAWN BY L.M. PITRE 6-8-92
PARKING
WW-3
WW-1
WW-2
OW-50
OW-51
MERCURY CELL BUILDING
OW-49
OW-48
OW-9
OW-10A
DOW-1
OW-28
OW-27
SWMU 2
FORMER SOUTH IMPOUNDING BASIN
OW-6A
OW-5A
DATE
NO.
REVISION
BY
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NIAGARA FALLS, NEW YORK
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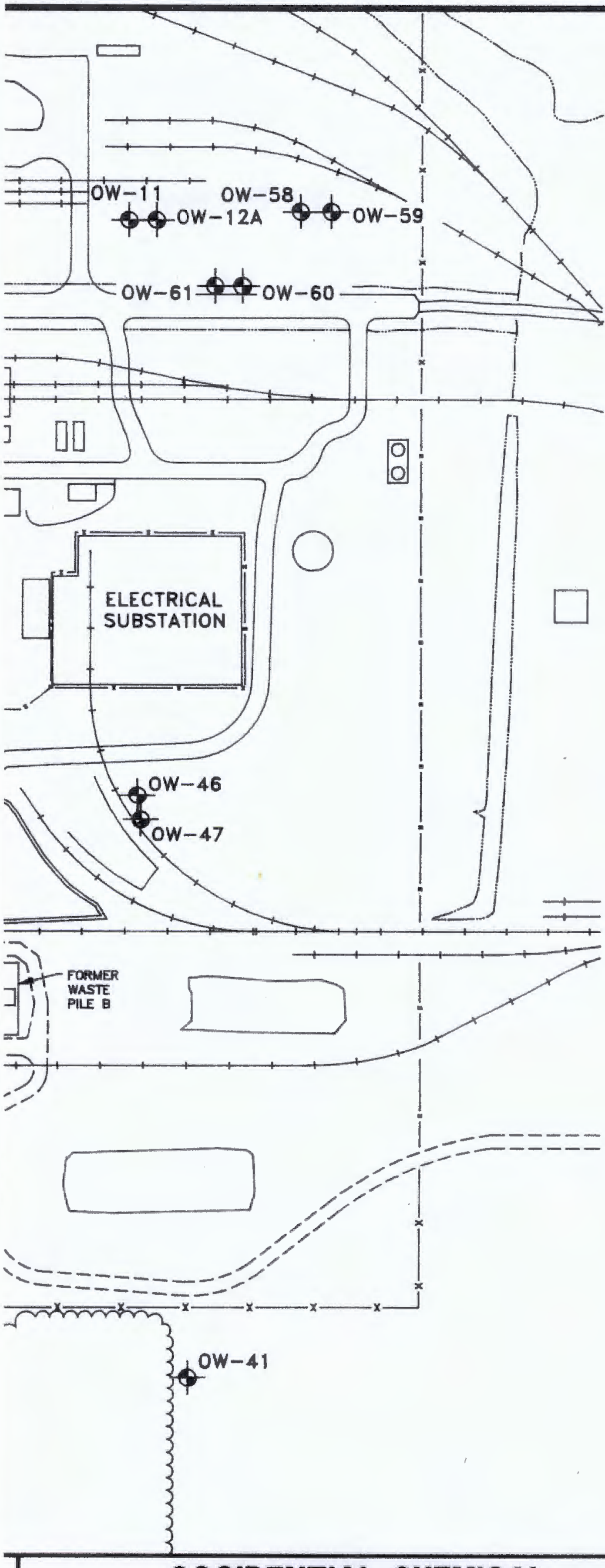

LEGEND

- OBSERVATION WELL LOCATION
- WATER WELL (ABANDONED)
- SOLID WASTE MANAGEMENT UNIT (SWMU)
- PROPOSED BORING TO BEDROCK
- PROPOSED 20 FOOT BORING LOCATION

0 feet 200
SCALE

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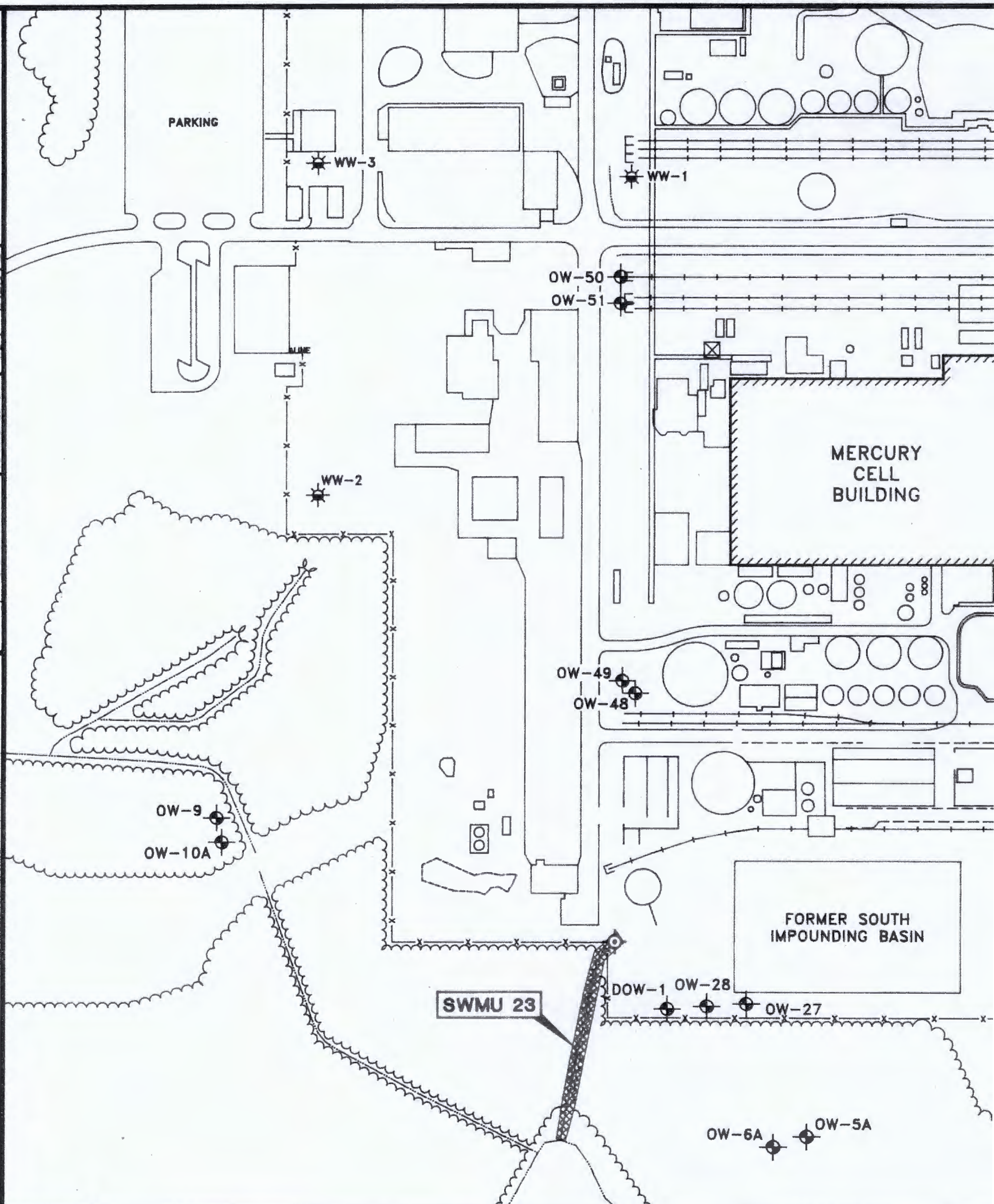
OCCIDENTIAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**RFI SAMPLING PLAN SWMU 2 (FORMER SOUTH IMPOUNDING BASIN**	**9-1** Fig. No.



DRAWN BY	L.M. PITRE 6-8-92
CHECKED BY	6/25/92
APPROVED BY	6/25/92
DRAWING NO.	87-0188-B192

DATE	NO.	REVISION	BY

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NIAGARA FALLS, NEW YORK
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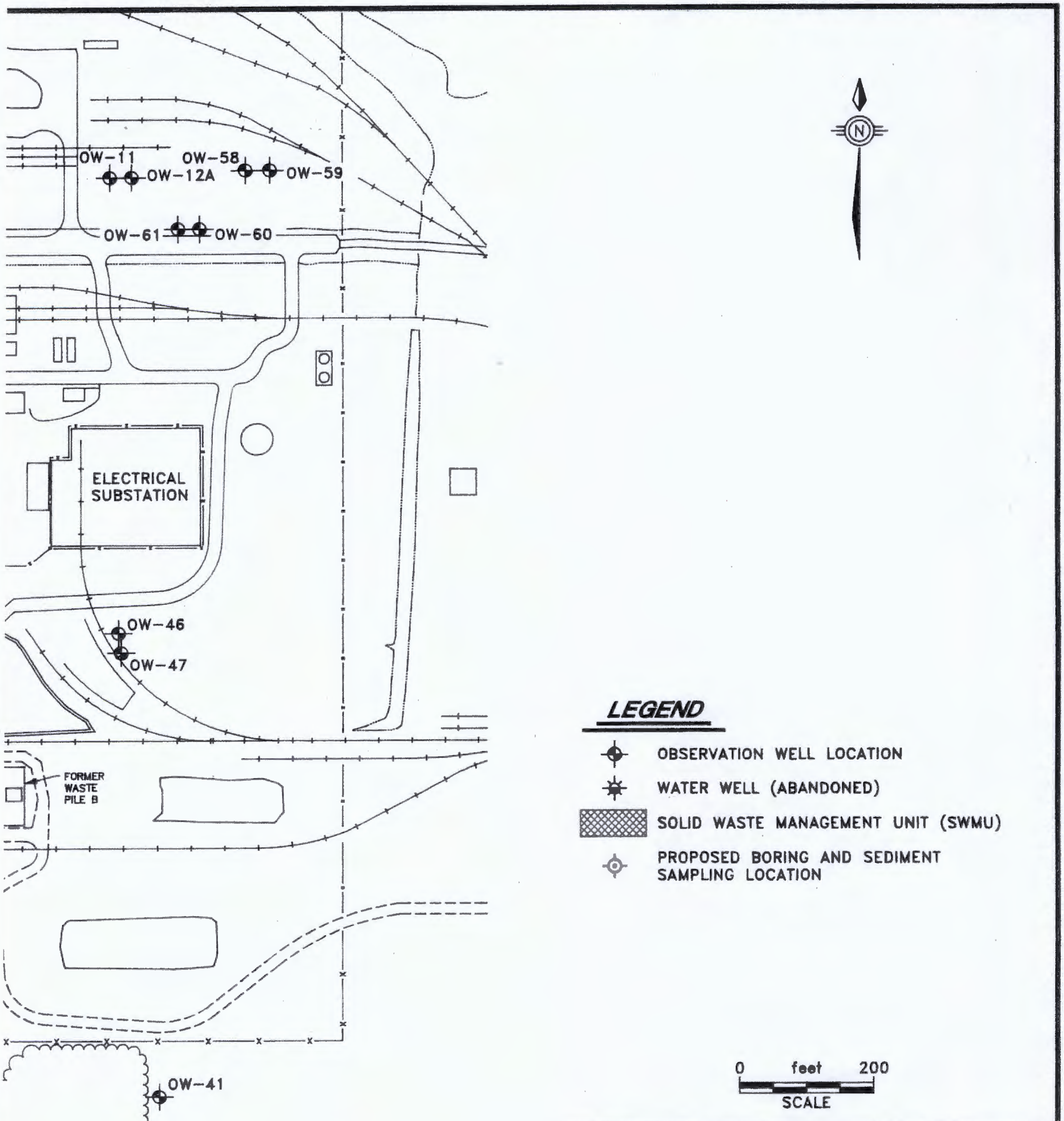

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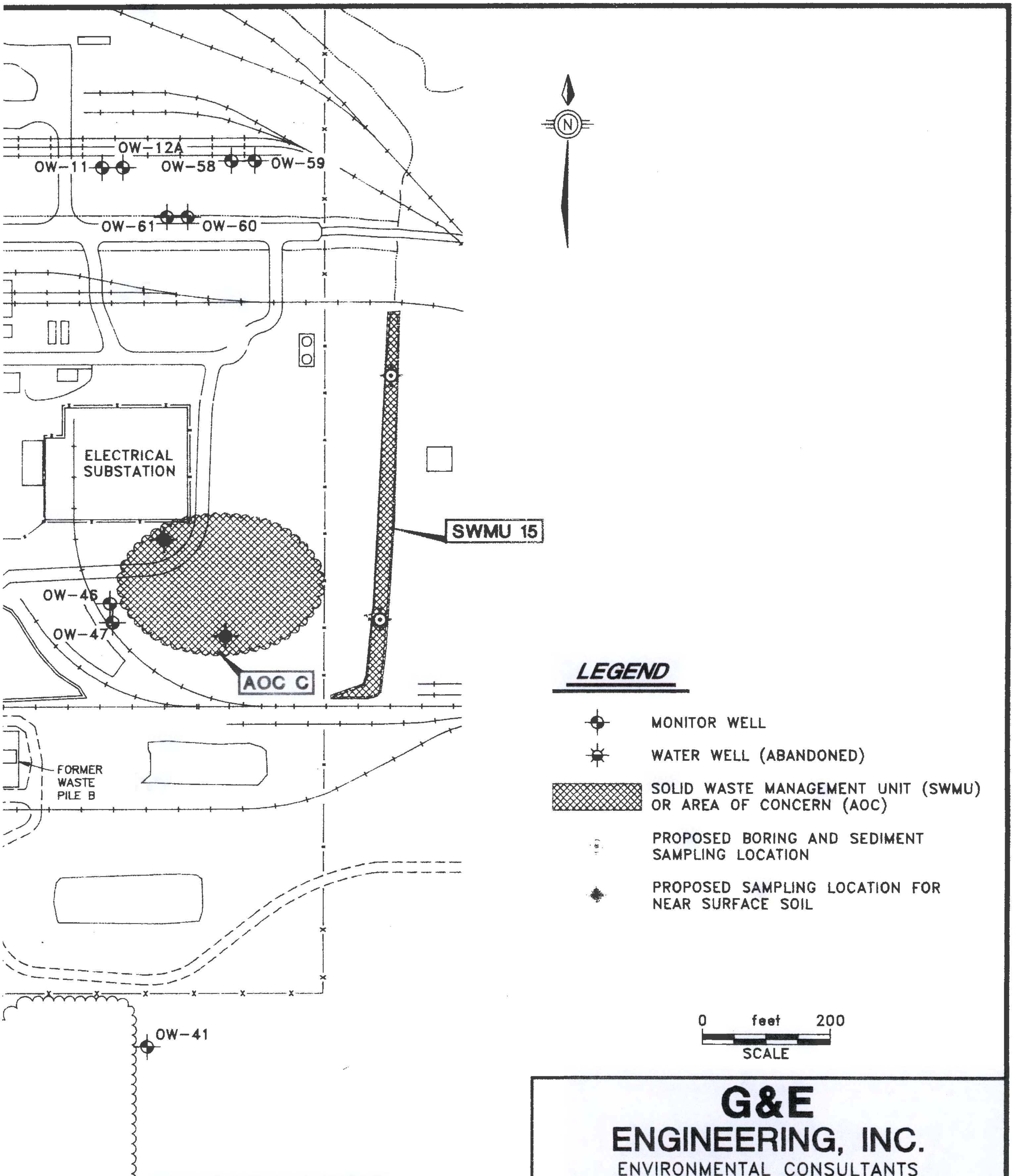
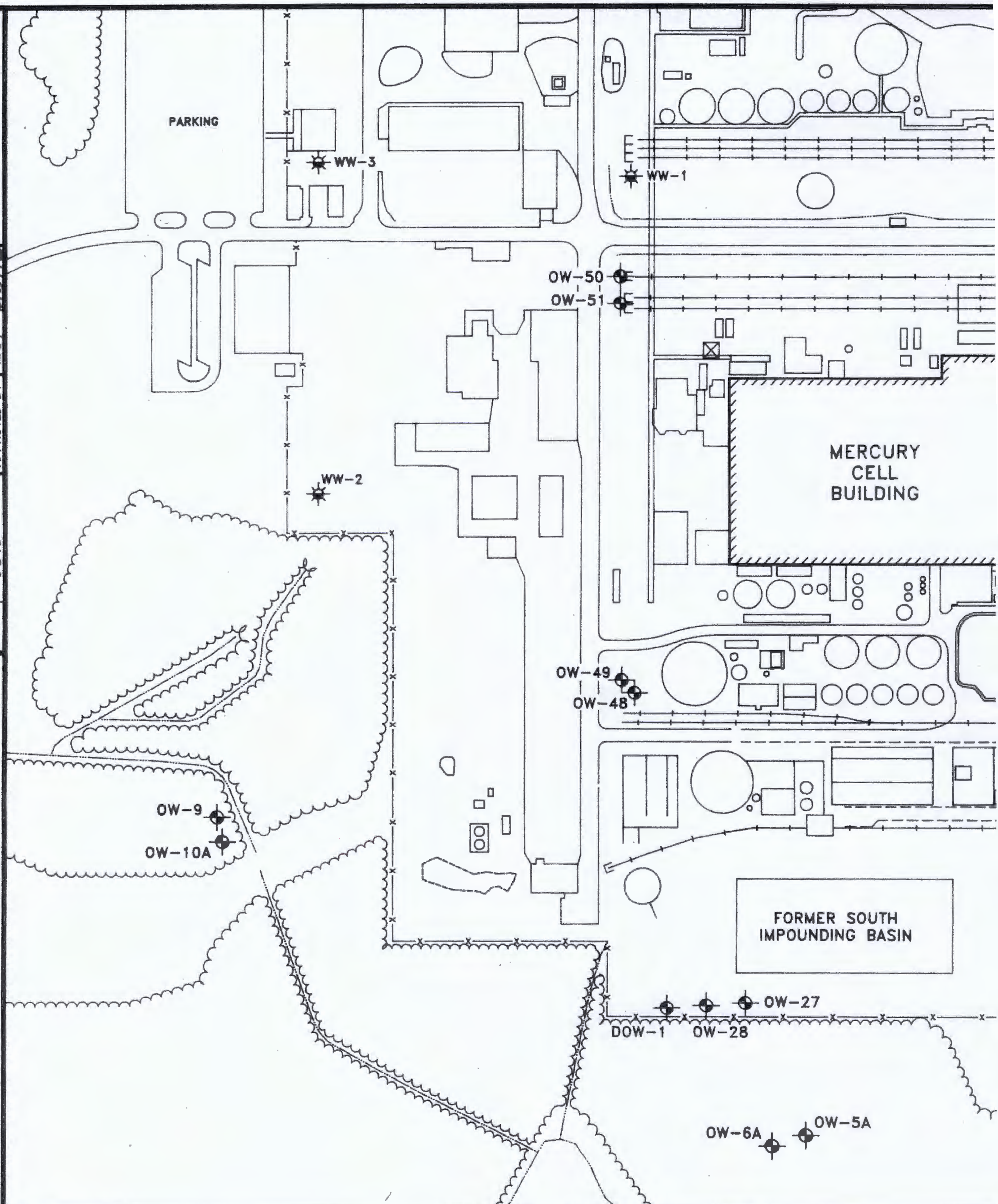
OCCIDENTIAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**RFI SAMPLING PLAN, SWMU 23 (SOUTHERN STORMWATER DISCHARGE DITCH)**	**14-1** Fig. No.



G&E ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTIAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**RFI SAMPLING PLAN SWMU 15 [OLD EAST OUTFALL DITCH] AND AREA OF CONCERN [AOC] C [GRAVEL AREAS]**	**16-1** Fig. No.



DRAWN BY	L.M. PITRE 6-8-92
CHECKED BY	6/25/92
APPROVED BY	6/25/92
DRAWING NO.	87-0188-B191

DATE	NO.	REVISION	BY

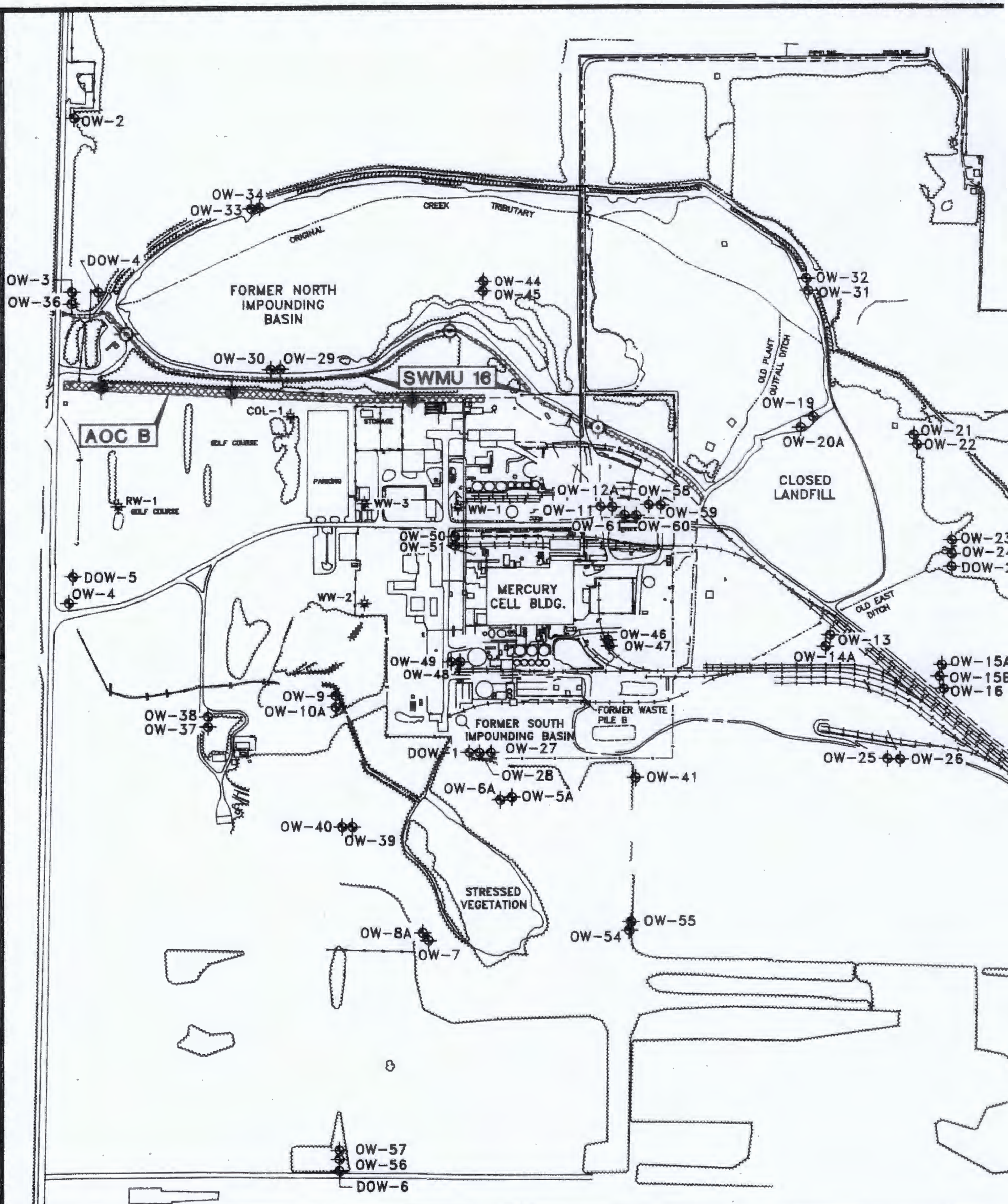
OCCIDENTIAL CHEMICAL CORPORATIO

NIAGARA FALLS, NEW YORK

Client

DRAWING NO. 87-0188-B193

DRAWN BY	L.M.PITRE	6-11-92
CHECKED BY		6/25/92
APPROVED BY		6/25/92

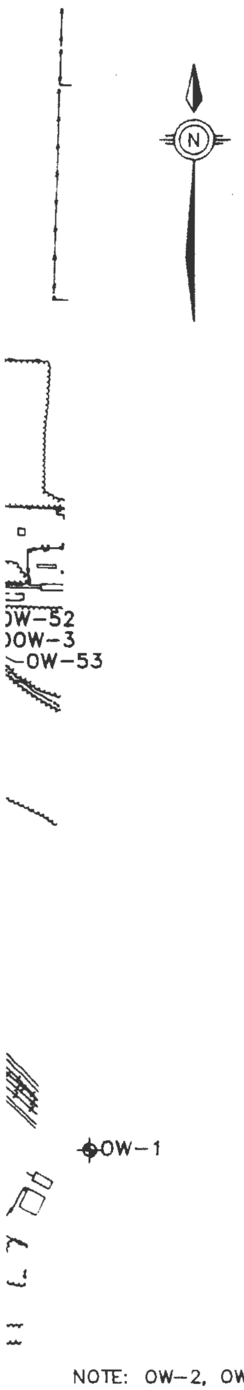


DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATION

NIAGARA FALLS, NEW YORK

Client



LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- SOLID WASTE MANAGEMENT UNIT (SWMU) OR AREA OF CONCERN (AOC)
- PROPOSED BORING AND SEDIMENT SAMPLING LOCATION
- PROPOSED SOIL SAMPLING LOCATION

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

0 feet 600

SCALE

G&E ENGINEERING, INC.

ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY

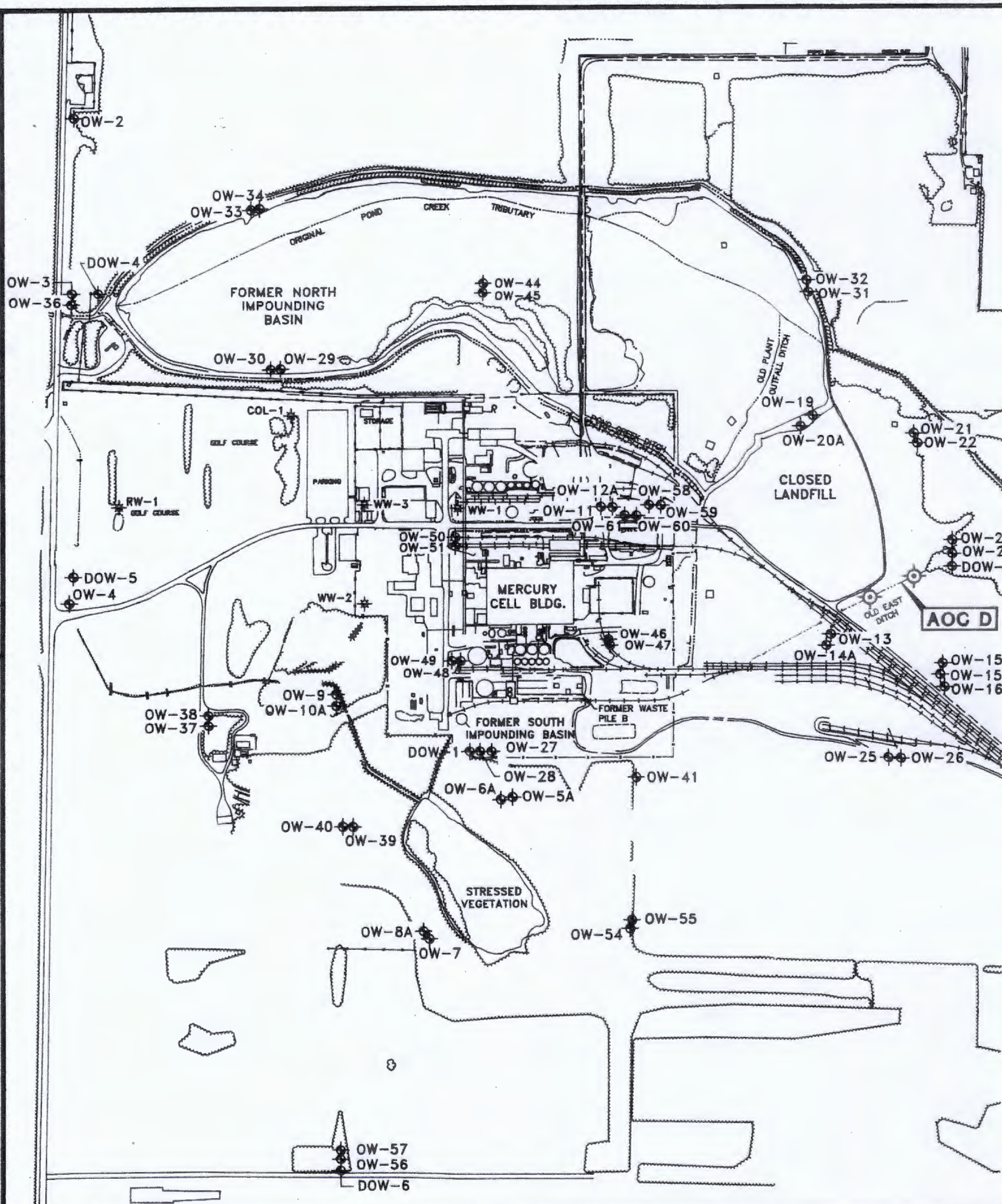
MUSCLE SHOALS, ALABAMA

Project Title

RFI SAMPLING PLAN SWMU 16 (NPDES OUTFALL DITCH) AND AOC B (OLD TVA PIPELINE RIGHT-OF-WAY)

19-1

Fig. No.



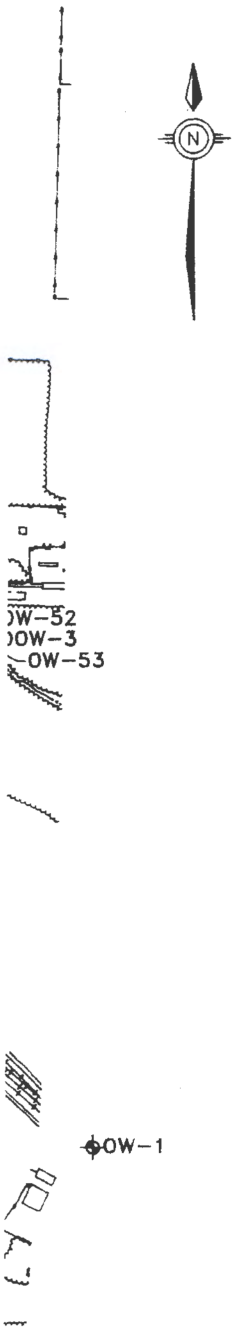
DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NO.
L.M.PITRE 6-11-92	6/25/92	6/25/92	87-0188-B194

DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATIO

NIAGARA FALLS, NEW YORK

Client



LEGEND

- MONITOR WELL LOCATION
- WATER WELL (ABANDONED/CLOSED)
- AREA OF CONCERN (AOC)
- PROPOSED BORING AND SEDIMENT SAMPLING LOCATION

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS, WELL NOS. OW-17, OW-18, OW-35, OW-42 AND OW-43 NOT USED.

0 feet 600
SCALE

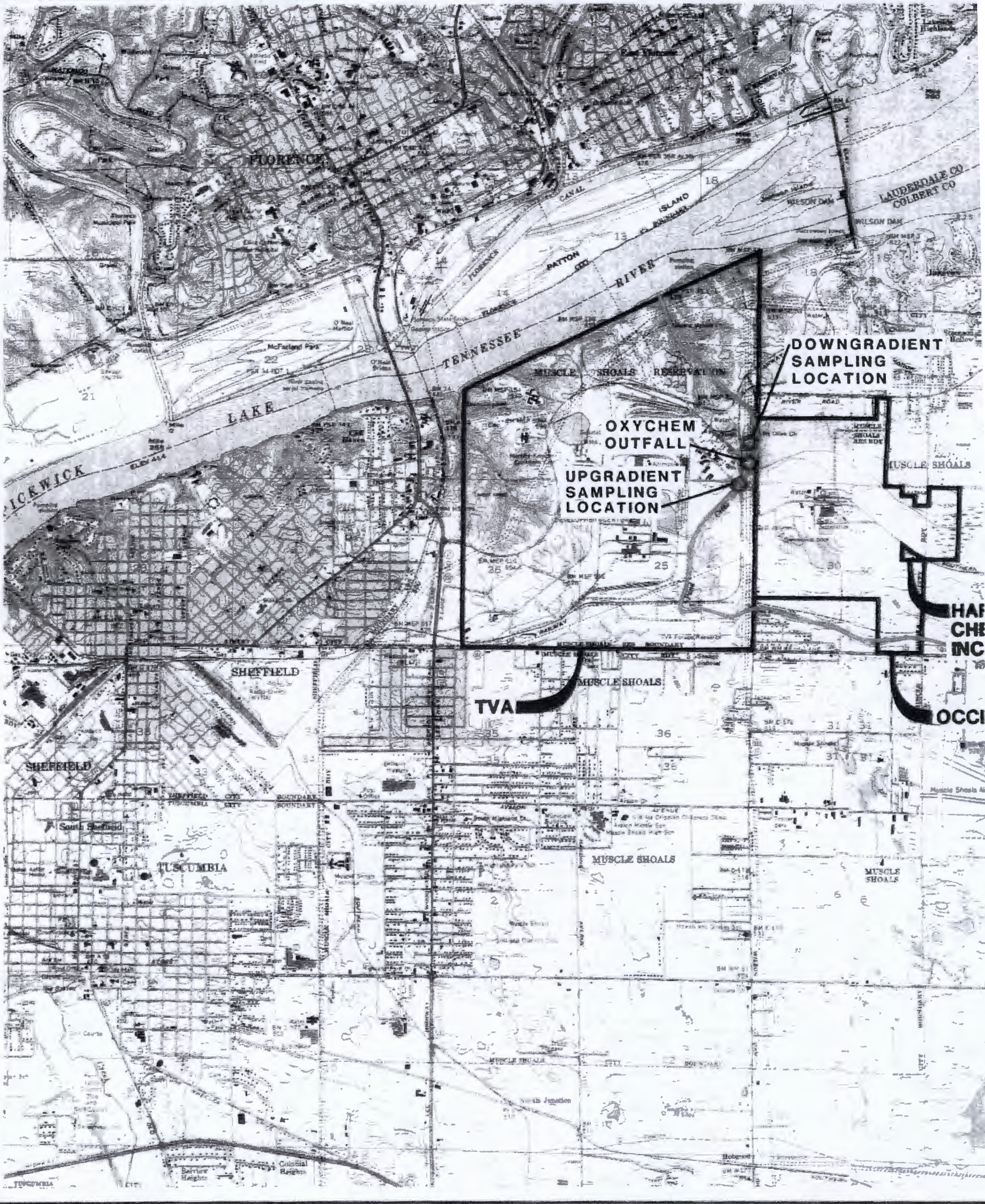
G&E ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

RFI SAMPLING PLAN AOC D (OLD EAST DITCH)

21-1
Fig. No.

DRAWN BY	L.M. PITRE 5-26-92	CHECKED BY	6/25/92	APPROVED BY	6/25/92	DRAWING NO. 87-0188-B195

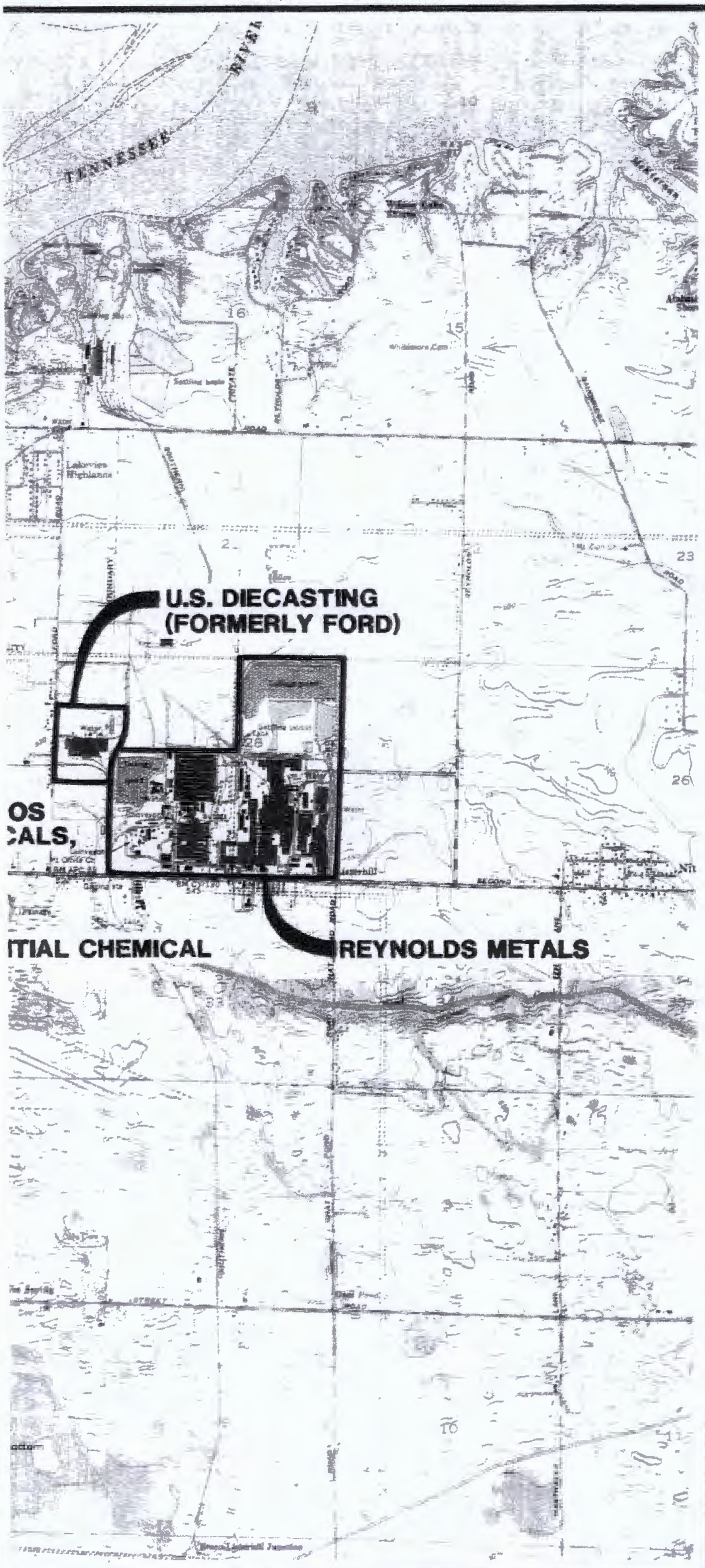


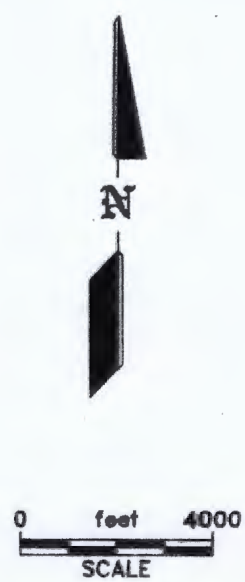
DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATIO

NIAGARA FALLS, NEW YORK

Client





RE: U.S.G.S. 7.5 MINUTE SERIES QUADRANGLE MAP, FLORENCE, ALA. 1971; KILLEN, ALA. 1971; LEIGHTON, ALA. 1971; TUSCUMBIA, ALA. 1971.

G&E
ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

OCCIDENTAL CHEMICAL CHLOR-ALKALI FACILITY MUSCLE SHOALS, ALABAMA Project Title	**RFI SAMPLING PLAN OFF-SITE AREA (POND CREEK)**	**22-1** Fig. No.

EXHIBIT 1-1

MAY 6, 1991 USEPA LETTER

REFERENCE WASTE PILES A AND B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

MAY 6 1991

4WD-RCRA&FFB

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Gerry Clark
Plant Manager
Occidental Electrochemicals
Wilson Dam Road
P.O. Box 1000
Sheffield, AL 35560

RE: Occidental Electrochemicals - Sheffield, AL
ALD 004 019 642
RCRA Post-Closure Care Permit Requirements
40 CFR §264 - Interim Status Clean Closure Equivalency Standards

Dear Mr. Clark:

In late 1987, changes to the Resource Conservation and Recovery Act regulations extended post-closure care permit requirements to waste piles, surface impoundments and land treatment units that closed by removal (popularly called clean closed) under 40 CFR Part 265 interim status closure standards. These changes were promulgated by revision to 40 CFR §270.1(c) on December 1, 1987, (52 FR 45788, et.seq.,) and specify that owners and operators of landfills, surface impoundments, waste piles and land treatment units that received wastes after July 26, 1982, or certified closure according to 40 CFR §265.115 after January 26, 1983, must have post-closure care permits unless they demonstrate that their interim status clean closure is equivalent to clean closure under 40 CFR §264. Procedures for requesting the equivalency determination are found in 40 CFR §270.1(c)(5) and (6) and are enclosed for your convenience. If an equivalency determination is not justified, a Part B permit application for post-closure care will be required when called by the Environmental Protection Agency (EPA).

Also enclosed are guidance materials, prepared by EPA - Region IV, to be utilized when preparing a closure equivalency demonstration. All demonstrations submitted to EPA must include, at a minimum, (1) detailed information regarding the procedures used to close each unit for which equivalency is being demonstrated and (2) groundwater data which supports the demonstration. The required groundwater data must be derived from a monitoring system which is capable of detecting releases from the specific units subject to the clean closure equivalency standards. If your present groundwater monitoring system does not have the necessary detection capabilities, you have the alternative of modifying the existing system, or installing a new system if none exists, so that 40 CFR Part 264 groundwater monitoring standards are met. In this case, a proposed groundwater monitoring plan and implementation schedule must also be submitted to EPA for approval.

The decision of whether to request an equivalency determination is left to the facility. To allow EPA - Region IV to determine the number of facilities which will petition for an equivalency determination, we request that you notify us within thirty (30) days of receipt of this letter of your intentions for addressing the closure equivalency requirements. Please note that this is not a request for submittal of an equivalency demonstration nor a call for a post-closure Part B application. EPA will begin formally calling for submittal of equivalency demonstrations during calendar year 1991; Part B applications will be called at a later date. This is merely a request for information.

Please address your response to:

U.S. Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365
Attention: James H. Scarbrough

If you should have any questions regarding this matter, please contact Laurie Mitchell of my staff at (404) 347-3433.

Sincerely yours,

Douglas C. McCurry for

James H. Scarbrough, P.E., Chief
RCRA & Federal Facilities Branch
Waste Management Division

Enclosures: 1) Guidance document, "Guidance on Demonstrating Equivalence of Part 265 Clean Closures with Part 264 Requirements", May 12, 1989
2) Copy of EPA - Region IV, Guidance for Preparing Clean Closure Equivalency Demonstrations
3) Copy of 40 CFR §270.1(c)(5) and (6)

cc: Sue Robertson, ADEM
Pat Anderson, EPA

EXHIBIT 1-2

RFA REPORT TEXT

OCCIDENTAL CHEMICAL CORPORATION

MUSCLE SHOALS FACILITY

MUSCLE SHOALS, ALABAMA

EPA ID ALD 004 019 642

Kearney/Centaur Division
A.T. Kearney, Inc.
1100 Abernathy Road, Suite 900
Atlanta, Georgia 30328-5603
404 393 9900
Facsimile 404 396 3091

Management
Consultants

February 21, 1992

ATKEARNEY

Ms. Rowena Sheffield
Regional Project Officer
U.S. Environmental Protection Agency
345 Courtland Street NE
Atlanta, Georgia 30365

Reference: EPA Contract No. 68-W9-0040; Work Assignment No. R04-19-14; Occidental Chemical; Muscle Shoals, Alabama; EPA I.D. No. ALD004019642; RCRA Facility Assessment; Final Deliverable

Dear Ms. Sheffield:

Enclosed please find the RCRA Facility Assessment (RFA) for the above-referenced facility. This report presents the results of the Preliminary Review (PR) and the Visual Site Inspection (VSI). The RFA resulted in the identification of 25 Solid Waste Management Units (SWMUs) and 4 Areas of Concern (AOCs).

The Occidental Chemical Corporation (OxyChem) facility in Muscle Shoals, Alabama is a chlor-alkali plant that currently produces chlorine, potassium hydroxide, potassium carbonate, and hydrogen gas. For several decades and until 1991, the facility also produced sodium hydroxide.

Extensive groundwater and soil contamination has been documented beneath the facility. Principal constituents detected include chlorides, mercury, and cadmium. Groundwater beneath the site occurs in an Upper Zone, a Lower Zone and a Deep Zone. Groundwater assessment studies have characterized the mercury and chloride plumes as originating in the vicinity of the Landfill (SWMU 1), the Former South and North Impounding Basins (SWMUs 2 and 3), the Former Salt Storage Piles (SWMU 4), the Mercury Cell Room Trench System (SWMU 7), process units outside the cell building, the Industrial Sewer System (SWMU 14), the Old East Outfall Ditch (SWMU 15), the Southern Stormwater Discharge Ditch (SWMU 23), and the Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24).

OxyChem is currently under an Administrative Order and compliance schedule to complete additional groundwater assessment and implement corrective action. Based on an agreement between Region IV EPA and OxyChem, confirmatory sampling will not be conducted as part of the RFA. Instead, conclusions reached during the RFA will be incorporated into the RCRA Facility Investigation (RFI). Consequently, only two courses of action were considered for recommendation in this RFA: a RFI or no further action. The units listed below have been designated for participation in the RFI:

- Landfill (SWMU 1)
- Former South Impounding Basin (SWMU 2)
- Former North Impounding Basin (SWMU 3)
- Salt Storage Piles (SWMU 4)
- Sludge Pads (SWMU 6)
- Mercury Cell Room Trench System (SWMU 7)
- Former Hypalon-Lined Storage Tank Location (SWMU 8)
- Mercury Collection Vessel (SWMU 10)
- Scrubber Solution Treatment Tank (SWMU 13)
- Industrial Sewer System (SWMU 14)
- Old East Outfall Ditch (SWMU 15)
- Southern Stormwater Discharge Ditch (SWMU 23)
- Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24)
- Waste Pile Storage Areas (SWMU 25)
- Junkyard (AOC A)
- Old TVA Pipeline Right-of-Way (AOC B)
- Gravel Covered Area Adjacent to Electric Substation (AOC C)
- Old East Ditch (AOC D)

No further action is suggested for the remaining units, provided the facility remains in compliance with the applicable permits. As an interim measure, it is suggested that the facility immediagely discontinue the practice of releasing wastewater from the Mercury Collection Vessel (SWMU 10) to the Industrial Sewer System (SWMU 14). There should also be an evaluation of an offsite area (Pond Creek) because it has historically received wastewaters with high mercury concentrations from the facility. Refer to the Executive Summary Table for a synopsis of the facility SWMUs and AOCs.

Per EPA's request, this deliverable has been double-sided and reproduced on recycled paper. Please contact me if you have any questions concerning this report.

Sincerely,

Denise Turner

A. Denise Turner, Ph.D.
Technical Director

Enclosure

cc: P. Anderson, EPA Region IV
G. Hardy, ADEM
W. Jordan
L. Poe
D. Scott
D. Anderson, KWBES
L. Potts, Baker

RCRA FACILITY ASSESSMENT

OF

OCCIDENTAL CHEMICAL CORPORATION
MUSCLE SHOALS, ALABAMA

EPA I.D. NO. ALD004019642

SUBMITTED BY:

BROWN ENVIRONMENTAL SERVICES
6A GRAHAM ROAD
COLLEGE STATION, TEXAS 77845

SUBMITTED TO:

A.T. KEARNEY, INC.
1100 ABERNATHY ROAD
ATLANTA, GEORGIA 30328

FOR SUBMISSION TO:

MS. ROWENA SHEFFIELD
REGIONAL PROJECT OFFICER
U.S. EPA REGION IV
345 COURTLAND STREET NE
ATLANTA, GEORGIA 30365

IN RESPONSE TO:

EPA CONTRACT NO. 68-W9-0040
WORK ASSIGNMENT NO. R04-19-14

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I. EXECUTIVE SUMMARY

The 1984 Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) authorized EPA to require corrective action for releases of hazardous wastes and/or hazardous constituents from Solid Waste Management Units (SWMUs) and other Areas of Concern (AOCs) at all operating, closed or closing RCRA facilities. The intention of this authority is to address previously unregulated releases to air, surface water, soil, and groundwater. The first phase of the corrective action program, as established by EPA, is development of a RCRA Facility Assessment (RFA). The RFA includes a Preliminary Review (PR) of all available relevant documents, a Visual Site Inspection (VSI) and, if appropriate, a Sampling Visit (SV). Based on the results of the PR and VSI, waste management operations at Occidental Chemical Corporation (OxyChem) have been described along with various SWMUs and AOCs at the facility. In addition, these investigations have assessed each SWMU or AOC as to its potential for release of hazardous constituents and its need for corrective action.

This RFA is based on a PR of files from EPA Region IV and the Alabama Department of Environmental Management (ADEM), and a VSI. The PR was performed during November 1991, and the VSI was conducted on December 12 and 13, 1991.

The OxyChem plant site is located northeast of Muscle Shoals, Alabama, approximately two miles south of the Tennessee River. Facility property includes a total of 720 acres. The plant site is centered on approximately 80 acres which includes production areas, a golf course, leased-out cotton fields, and undeveloped woodlands. The plant was constructed in 1952 and purchased by OxyChem in 1986. The plant produces chlorine, potassium hydroxide, potassium carbonate and hydrogen gas (Ref. 2).

Current and former operating areas within the plant include the Mercury Cell Room Trench System (SWMU 7), the Former North Impounding Basin (SWMU 3), the Former South Impounding Basin (SWMU 2), Salt Storage Piles (SWMU 4), the Landfill (SWMU 1), the Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24), the wastewater treatment plant (SWMUs 19-22) and the Industrial Sewer System (SWMU 14). Improvements in power distribution and mercury cell construction have resulted in the growth of plant capacity from 150 tons of chlorine per day to a current capacity in excess of 400 tons of chlorine per day. In addition, modifications to plant operations appear to have improved the recovery of mercury from process areas.

Chlorine, mercury and cadmium are found to varying degrees in each of the plant's solid waste streams. Solid wastes generated at the OxyChem plant include brine sludges, brine filter, backwash muds, saturator sludges, assorted carbon filter packs/cakes, and industrial wastewater sump sludges. Solid wastes were landfilled onsite until offsite disposal began in February 1980.

Extensive groundwater contamination has been documented beneath the OxyChem facility. Principal constituents detected in soil and groundwater include chlorides, mercury and cadmium. The areas which appear to have been the primary sources of contaminant release to soil and groundwater include the Salt Storage Piles (SWMU 4), the Industrial Sewer System (SWMU 14), former discharge of excess brine to the Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24), the Former North Impounding Basin (SWMU 3), the Former South Impounding Basin (SWMU 2), several unlined discharge ditches (SWMUs 15, 16, 23, and AOC D), the Mercury Cell Room Trench System (SWMU 7), and the Landfill (SWMU 1). Other possible sources of contaminant releases include the Gravel Areas Adjacent to Electrical Substation (AOC C) where contaminated stormwater could have seeped into the ground, and the former sites of unenclosed bulk waste management (SWMUs 6 and 25). Close examination of the Gravel Areas Adjacent to Electrical Substation (AOC C) also revealed oily stains beneath the surficial gravel layer.

The extent of elevated chloride levels to the east of the Landfill (SWMU 1) had not been characterized as of 1989. Elevated cadmium concentrations in groundwater are centered on the area south of the Mercury Cell Building. Excess brine, containing mercury and cadmium, has been discharged from facility process areas in a variety of ways, including into a natural low area south of the Mercury Cell Building. Contact wastewaters and contaminated stormwater runoff were in the past discharged to the Industrial Sewer System (SWMU 14), unlined ditches (SWMUs 15, 16, and 23, and AOC D), the Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24), and the unlined Former North and South Impounding Basins (SWMUs 2 and 3).

OxyChem has obtained closure approval from the State of Alabama for the Waste Pile Storage Areas (SWMU 25). In addition, the Alabama Department of Public Health expressed concerns about the plant Landfill (SWMU 1) in 1980. Groundwater sampling between 1988 and 1989 revealed concentrations as high as 93,500 ppm chloride, 340 ppb mercury, and 330 ppb cadmium. Based on these data, the Alabama Department of Environmental Management (ADEM) issued a Notice of Violation to OxyChem. The facility is currently under an ADEM Administrative Order and a compliance schedule to complete additional groundwater assessment and to propose and implement corrective action.

A total of 25 SWMUs and 4 AOCs were identified at the OxyChem Muscle Shoals Plant as a result of the PR and VSI. Refer to Table I-1 for a synopsis of the facility SWMUs and AOCs. The Agency and facility have agreed to eliminate the confirmatory sampling step and proceed directly to the RCRA Facility Investigation (RFI). Consequently, only a RFI or no further action was suggested in this RFA. The units listed below have been designated for participation in the RFI:

- Landfill (SWMU 1)
- Former South Impounding Basin (SWMU 2)
- Former North Impounding Basin (SWMU 3)
- Salt Storage Piles (SWMU 4)
- Sludge Pads (SWMU 6)
- Mercury Cell Room Trench System (SWMU 7)
- Former Hypalon-Lined Storage Tank Location (SWMU 8)
- Mercury Collection Vessel (SWMU 10)
- Scrubber Solution Treatment Tank (SWMU 13)
- Industrial Sewer System (SWMU 14)
- Old East Outfall Ditch (SWMU 15)
- Southern Stormwater Discharge Ditch (SWMU 23)
- Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24)
- Waste Pile Storage Areas (SWMU 25)
- Junkyard (AOC A)
- Old TVA Pipeline Right-of-Way (AOC B)
- Gravel Areas Adjacent to Electric Substation (AOC C)
- Old East Ditch (AOC D)

No further action is suggested for the remaining units, provided the facility remains in compliance with the applicable permits. An interim measure, it is suggested that the facility immediately discontinue the practice of releasing wastewater from the Mercury Collection Vessel (SWMU 10) to the Industrial Sewer System (SWMU 14).

It is apparent from the facility-wide nature of the contamination, that the entire facility should be considered in the RFI. In some cases, past investigations have documented the existence but not the full extent of contamination. It should be a central premise of the RFI that both the horizontal and lateral extent of contamination will be fully defined. The facility should also remediate the existing contamination and deal effectively with the sources of continuing release(s) to the environment.

An evaluation of an offsite area (Pond Creek) has also been suggested because it has historically received facility wastewaters with high mercury concentrations. Sediment samples should be collected at designated intervals along its length and also in areas of the creek where sediments may accumulate. The purpose of this investigation should be to determine the magnitude and extent of contamination. The sampling should continue along the length of the creek until it is determined that no contaminated sediments were detected at three or more sampling locations.

TABLE I-1.
OCCIDENTAL CHEMICAL CORPORATION
EXECUTIVE SUMMARY TABLE.

	SWMU/AOC	Type of unit	Years in operation	Wastes managed[a]	Pollution migration pathways[b]	Evidence of releases	Exposure potential[c]	Recommendation: RFI	Recommendation: No further action
1	Landfill	landfill	1955–1980	A, B, C, D, E	A, SW, S, GW, SS	yes	U	X	
2	Former South Impounding Basin	surface impoundment	1970–1976	E	A, SW, S, GW, SS	yes	U	X	
3	Former North Impounding Basin	surface impoundment	1970–1971	E, F, G	SW, S, GW	yes	U	X	
4	Salt Storage Piles	bulk product storage	1953–1991		S, GW	yes	L	X	
5	Brine Filter Backwash Collection Tank	tank	1990–present	A		no	L		X
6	Sludge Pads	waste storage area	1953–present	B	S, GW	no	U	X	
7	Mercury Cell Room Trench System	trenches/sump	1953–present	E	S, GW	yes	U	X	
8	Former Hypalon-Lined Storage Tank Location	tank	1976–1981	E, G		no	L	X	
9	Mercury Retort Tanks	tanks	1988–present	C, D		no	L		X
10	Mercury Collection Vessel	tanks	1988–present	E	S, GW	yes	U	X	
11	Hazardous Waste Roll-Off Pad	storage pad	1985–present	A, C, K, M		no	L		X
12	Emergency Chlorine Scrubber Tanks	tanks	1974–present	I		no	L		X
13	Scrubber Solution Treatment Tanks	tanks	1974–present	J	SW, S	no	L	X	
14	Industrial Sewer System	sewer system	1953–present	E, F, G	A, SW, S, GW, SS	no	U	X	
15	Old East Outfall Ditch	ditch	1953–present	E, F, G, S	SW, S, GW	no	U	X	
16	NPDES Outfall Ditch	ditch	1971–present	E, F, G, S	SW, S, GW	no	L		X
17	Wastewater Treatment Frame Filter Presses	filters	1974–present	A, K		no	L		X
18	Former PCB Storage Area	temporary storage	1980–1987	L		no	L		X
19	500,000-gallon Wastewater Storage Tank	tank	1981–present	E, G		no	L		X
20	Wastewater Treatment Hydrazine Reaction Tank	tank	1974–present	E		no	L		X
21	Wastewater Treatment Carbon Polishing Towers	tank	1974–present	F		no	L		X
22	Carbon Tetrachloride Stripper	tank	1956–present	N		no	L		X
23	Southern Stormwater Discharge Ditch	ditch	unknown–present	G, P	SW, S, GW	yes	U	X	
24	Stressed Vegetation Area South of Former South Impounding Basin	discharge area	unknown–present	G, P	SW, S, GW	yes	U	X	
25	Waste Pile Storage Areas	waste piles	1980–1984	A, C, D, H, K, M, N, O	S, GW	no	U	X	
A	Junkyard	storage area	unknown–present	O	SW, S	no	L	X	
B	Old TVA Pipeline Right-of-Way	right-of-way	unknown–present		SW, S	no	L	X	
C	Gravel Areas Adjacent to Electrical Substation	surface spill	unknown–present	Q	SW, S, GW	no	L	X	
D	Old East Ditch	earthen ditch	unknown	E, F, G, R	SW, S, GW	yes	U	X	

a A = brine sludges (K071); B = saturator precipitates; C = assorted carbon filter packs/cakes; D = industrial wastewater sump sludges; E = untreated wastewaters; F = treated wastewaters; G = stormwater runoff; H = used motor oil; I = sodium hypochlorite; J = treated scrubber solution; K = wastewater treatment sludges (K106); L = PCB-containing oils and debris from SCP spills; M = D009 waste; N = F001 waste; O = used equipment; P = excess brines; Q = unidentified spilled materials; R = leachate seeping from the landfill; S = washwater from tank cars, barge tanks, and chlorine storage tanks.

b GW = groundwater; SW = surface water; S = soil, A = air; SS = subsurface gas.

c L designates a low, M designates a moderate, H designates a high, and U designates an unknown exposure potential; see SWMU description for substantiation.

EXHIBIT 1-3

MARCH 25, 1992 OXYCHEM LETTER TO USEPA

ADDENDUM TO RFA REPORT

Occidental Chemical Corporation

March 25, 1992

Ms. Beverly Williams
Chief, AL/MS Unit
RCRA Permitting Section
United States Environmental
Protection Agency (EPA)
345 Courtland Street, N.E.
Atlanta, Georgia 30365

Re: RCRA Facility Assessment
Report
Occidental Chemical
Corporation
Muscle Shoals, Alabama
EPA I.D. Number ALD 004 019 642

Dear Ms. Williams:

On March 4, 1992, Occidental Chemical Corporation (OxyChem) received a copy of the RCRA Facility Assessment (RFA) report prepared by EPA's contractor for the OxyChem Muscle Shoals facility. OxyChem has reviewed the RFA report and found a number of inconsistencies, misstatements, and indications of apparent misunderstandings of reference material and information communicated during the Visual Site Inspection (VSI) that took place on December 12 and 13, 1991.

OxyChem's comments are provided as Attachment 1, which includes excerpts of the RFA report followed by an accompanying comment and/or suggested correction. The affected RFA pages are provided as Attachment 2 with the text in question underlined and labeled with same numbering system as Attachment 1.

Many of the comments are significant and markedly alter some of the concerns expressed in the RFA report. It is requested that OxyChem have an opportunity to address these comments with EPA and that they be appended to the RFA report for future reference.

OxyChem®
Electrochemicals & Specialty Products
Wilson Dam Road, P.O. Box 1000, Sheffield, Alabama 35660
205/389-2200

If you have any questions concerning the information presented in Attachment 1, please contact the undersigned.

Sincerely,

Chris L. Manley
Senior Environmental Engineer

cc: Pat Anderson, EPA Region IV
Sue Robertson, Chief, ADEM Land Division
Bob Kaczorowski, OxyChem Corporate Engineering
Vern Heble, OxyChem Corporate Environmental
Andy Lampert, Plant Technical Superintendent
Daniel E. Adams, G&E Engineering, Inc.

ATTACHMENT 1

RFA COMMENTS

OCCIDENTAL CHEMICAL CORPORATION

MUSCLE SHOALS FACILITY

MUSCLE SHOALS, ALABAMA

EPA ID ALD 004 019 642

RFA COMMENTS
OCCIDENTAL CHEMICAL CORPORATION
MUSCLE SHOALS FACILITY
MUSCLE SHOALS, ALABAMA
EPA I.D. ALD 004 019 642

(1) [Cover Letter page 2] Incomplete listing: The units listed below have been designated for participation in the RFI:

* Landfill (SWMU 1)
*
*
* Old East Ditch (AOC D)

Suggested Text Correction: The units listed below have been designated for participation in the RFI:

* Landfill (SWMU 1)
*
*
* Old East Ditch (AOC D)
* (ADD) NPDES Outfall Ditch (SWMU 16)

(2) [Cover Letter page 2] Incorrect Statement: As an interim measure, it is suggested that the facility immediately discontinue the practice of releasing wastewater from Mercury Collection Vessel (SWMU 10) to the Industrial Sewer System (SWMU 14).

Comment: The Mercury Collection Vessel (SWMU 10) does not discharge to the Industrial Sewer (SWMU 14) as indicated. The mercury contaminated wastewaters from the Mercury Collection Vessel (SWMU 10) flow into the cell room trench system. Wastewaters collected in the cell room trench system flow to the facility's wastewater treatment system.

Suggested Text Correction: Delete the statement.

(3) [I-3] Incomplete listing: Comment and Suggested Text Correction the same as RFA Comment (1).

(4) [I-3] Incorrect Statement: Comment and Suggested Text Correction the same as RFA Comment (2).

(5) [I-5] Table I-1 Recommendation Column Correction:

	Recommendation RFI	Recommendation No further action
16 NPDES Outfall Ditch		X

<u>Comment</u>: The SWMU 16 description found on page III-38 recommends "RFI Necessary (*)".

<u>Suggested Text Correction</u>:

	Recommendation RFI	Recommendation No further action
16 NPDES Outfall Ditch	X	

(6) [II-6] Incorrect Statement: The sludge materials are then passed through the <u>Wastewater Treatment Frame Filter Presses (SWMU 17)</u> for dewatering.

<u>Suggested Text Correction</u>: The sludge materials are then passed through the brine filter presses for dewatering.

(7) [II-6] Unit Error: Since the saturation and clarification steps utilized contact process brine waters recycled from the cell rooms, the brine sludge is contaminated with mercury at an average concentration of 10 <u>ppb</u> (according to facility personnel).

<u>Suggested Text Correction</u>. Substitute 10 ppm total mercury for 10 ppb.

(8) [II-6] Incorrect Waste Classification: The retorted carbon materials contain residual quantities of nonrecoverable mercury and are classified as <u>K106</u> waste.

<u>Suggested Text Correction</u>: Substitute D009 waste for K106 waste.

(9) [II-6 and II-7] Incorrect Statement: Additional mercury-bearing waste streams generated by rain or wash down in the brine and caustic filtration process areas of the facility are collected in the <u>Industrial Sewer System (SWMU 14) and routed for treatment or temporary storage</u>.

Comment: Mercury contaminated wastewaters are not allowed in the Industrial Sewer System (SWMU-14). Mercury contaminated wastewaters are collected in the wastewater collection system.

Suggested Text Correction: Additional mercury-bearing waste streams generated by rain or wash down in the brine and caustic filtration process areas of the facility are collected in the wastewater collection system.

(10) [II-7] Comment: The majority of the wastewater treatment sludge is retorted and recovered mercury returned to the process. The retorted sludge is classified as K106. This waste is transferred to temporary container storage for less than 90 days.

Suggested Text Insert: [Text] These treated wastewaters are routinely monitored for pH, chlorides and mercury according to the requirements of the facility's NPDES permit (reference 40). [INSERT] The majority of wastewater treatment sludge is retorted and recovered mercury returned to the process. The retorted sludge is classified as K106. This waste is transferred to temporary storage for offsite disposal at a RCRA-permitted landfill.

(11) [II-7] Incorrect Statement: Although facility personnel were unable to characterized or quantify the waste materials removed from the drying towers, they stated that such materials were generated only in insignificant quantities, and that the removal of such residual materials occurred only on an infrequent and irregular basis (i.e. every few years).

Suggested Text Correction: Facility personnel characterize the waste materials from the drying towers as ferric sulfates and ferric chlorides. Facility personnel also stated that such materials were generated only in insignificant quantities, and that the removal of such residual materials occurred only on an infrequent and irregular basis (e.g. every few years).

(12) [II-7] Incorrect Statement: Secondary recovery of chlorine vapors generates significant quantities of a hazardous waste (F001 spent halogenated solvents and/or still bottoms from such solvents).

Suggested Text Correction: Secondary recovery of chlorine vapors generates a hazardous waste (U211 and D019 spent carbon tetrachloride).

(13) [II-7] Incorrect Chemical Formula: The collected gaseous chlorine is pressurized, chilled and transferred to Carbon

Tetrachloride Stripper Unit (SWMU 22), where the chlorine is solubilized by carbon tetrachloride(<u>CH_4Cl_2</u>).

<u>Suggested Text Correction</u>: Substitute CCL_4 for CH_4Cl_2.

(14) [II-7] Incorrect Statement: Accumulated wastes <u>(F001 waste, distillation solvent and still bottoms)</u> are removed from the unit during routine maintenance operations.

<u>Suggested Text Correction</u>: Accumulated wastes (U211 and D019) are removed from the unit during routine maintenance operations.

(15) [II-10] Paragraph Insert Apparently Out Of Sequence: <u>This tributary stream formerly flowed roughly east to west and was centrally located in the area eventually occupied by the Former North Impounding Basin (SWMU 3). According to facility personnel, mercury concentrations in wastewaters generated during that period are believed to have averaged approximately two ppm</u>.

<u>Suggested Text Correction</u>: From 1953 to 1969, untreated facility wastewaters and noncontact process waters were routed through the Industrial Sewer System (SWMU 14) directly to the Old East Outfall Ditch (SWMU 15) and the Original Pond Creek Tributary. [INSERT] According to facility personnel, mercury concentrations in wastewaters generated during that period are believed to have averaged approximately two ppm. The Original Pond Creek tributary stream formerly flowed roughly east to west and was centrally located in the area eventually occupied by the Former North Impounding Basin (SWMU 3).

(16) [II-13] Incorrect Statement: The study conducted by G&E revealed the presence of elevated levels of mercury, cadmium and chlorides <u>in the underlying groundwaters of the Tuscumbia/ Fort Payne Aquifer, which is regionally utilized as a potable water source</u>.

<u>Comment</u>: The groundwater investigation has revealed that the elevated mercury, cadmium, and chloride are almost exclusively restricted to the saturated portion of the clay/chert regolith above the Tuscumbia/Fort Payne formations. The regolith is not a regional source of potable water, and as worded, the RFA conveys the incorrect impression that there is currently significant contamination of the underlying aquifer.

<u>Suggested Text Correction</u>: The study conducted by G&E revealed the presence of elevated levels of mercury, cadmium, and chlorides in the 40 to 60 feet of clay/chert regolith underlying the plant.

(17) [II-20] Incorrect Figure Reference: Although the direction of groundwater flow in the Upper Zone generally conforms with the surface topography, a pronounced groundwater mound is present underneath the facility process area (Figure II-7).

Suggested Text Correction: Substitute Figure II-9 for Figure II-7.

(18) [II-30] Incorrect Statement: In response, Occidental began submitting additional groundwater samples from locations across the facility for Appendix IX analyses.

Suggested Text Correction: While mercury and chlorides were constituents known to be present, elevated levels of cadmium were not expected. In response, Occidental began submitting additional groundwater samples from locations across the facility for cadmium analysis.

(19) [III-27] Incomplete Waste Listing: An approximate volume of 200 tons per year of retorted carbon materials (K106) are generated at the unit.

Suggested Text Correction: Substitute K106 and D009 for K106.

(20) [III-28] Incorrect Statement: Visual observations made at the time of the VSI suggested that there is routine release of mercury or mercury-contaminated wastewaters to the surrounding concrete and to the adjacent inlet to the Industrial Sewer System, SWMU 14 (see Photographs 10.1 and 10.2, Appendix B).

Suggested Text Correction: Visual observations made at the time of the VSI suggested that there is routine release of mercury or mercury-contaminated wastewaters to the surrounding concrete and to the adjacent inlet to the wastewater collection system (see Photographs 10.1 and 10.2, Appendix B).

(21) [III-28] Incorrect Statement: Visual observations made at the time of the VSI indicated that this tank may periodically release mercury or mercury-contaminated wastewaters to the Industrial Sewer System (SWMU 14) which in turn discharges to the NPDES Outfall Ditch (SWMU 16).

Suggested Text Correction: Visual observations made at the time of the VSI indicated that this tank may periodically release mercury or mercury-contaminated wastewaters to the wastewater collection system which in turn discharges to the wastewater treatment system.

(22) [III-28] Incorrect Statement: It is likely that hazardous constituents potentially released at the transfer box would

also be likely to drain into the Industrial Sewer System (SWMU 14) at other inlet points.

Comment: The mercury collection vessel and the adjacent transfer container box is operated on a concrete pad and is enclosed with concrete curbing. An inlet which is part of the wastewater collection system is located within the enclosed area, therefore, the potential for any hazardous constituents being released to the Industrial Sewer System (SWMU 14) does not exist.

Suggested Text Correction. Delete the statement.

(23) [III-29] Incorrect Statement: Furthermore, as an interim measure, the practice of uncontrolled release of mercury wastewaters to the surrounding area and the Industrial Sewer System (SWMU-14) should be decontaminated.

Comment: The Mercury Collection Vessel (SWMU 10) does not discharge to the Industrial Sewer (SWMU 14) as indicated. The mercury contaminated wastewaters from the Mercury Collection Vessel (SWMU 10) flow into the cell room trench system. Wastewaters collected in the cell room trench system flow to the facility's wastewater treatment system.

Suggested Text Correction: Delete the statement.

(24) [III-31] Incorrect Statement: The unit generates approximately 15 tons of waste per year. This waste is suspected to be hazardous, based on the characteristic of corrosivity (D003).

Suggested Text Correction. The unit generates approximately 100 tons of waste per year. This waste is treated in the plant's NPDES primary neutralization unit.

(25) [III-34] Incorrect Period of Operation: 1951-Present.

Suggested Text Correction: 1953 - Present

(26) [III-34] Incorrect waste classification: Prior to 1980, unknown quantities of F001 wastes (spent carbon tetrachloride solvents and still bottoms) generated at the Carbon Tetrachloride Stripper (SWMU 22) were also discharged to this unit.

Suggested Text Correction: Prior to 1980, unknown quantities of U211 and D019 wastes (spent carbon tetrachloride) generated at the Carbon Tetrachloride Stripper (SWMU 22) were also discharged to this unit.

(27) [III-36] Incorrect Statement: As an interim measure, the discharge from the Mercury Collection Vessel (SWMU 10) is an example of a continuing release of mercury contaminated waters entering the sewer system which should cease immediately.

Comment: The Mercury Collection Vessel (SWMU 10) does not discharge to the Industrial Sewer (SWMU 14) as indicated. The mercury contaminated wastewaters from the Mercury Collection Vessel (SWMU 10) flow into the cell room trench system. Wastewaters collected in the cell room trench system flow to the facility's wastewater treatment system.

Suggested Text Correction: Delete the statement.

(28) [III-39] Incorrect Statement: These presses, which filter K071 brine sludges piped from the Brine Clarifier Tanks (SWMU 5), are located in the vicinity of the wastewater treatment facility. Filtrate brine liquids passing through the filter units are returned to the electrolytic process.

Suggested Text Correction: Presses which filter mercury contaminated wastewaters are located in the vicinity of the wastewater treatment facility.

(29) [III-39] Incorrect Statement: These in-line filter units are part of the wastewater treatment system and are located outdoors approximately 50 feet from the remaining wastewater treatment units. KCl sludge materials generated at the unit are accumulated in subtending hoppers prior to transfer to the Mercury Retort Tanks (SWMU 9).

Suggested Text Correction. Wastewater sludge materials generated at the unit are accumulated in subtending hoppers prior to transfer to the Mercury Retort Tanks (SWMU 9).

(30) [III-39] Incorrect Statement: The frame and filter presses manage approximately 150 tons per year of wastewater treatment sludges (K106) and 600 tons per year of brine sludge (K071).

Comment: Brine sludge is not associated with the wastewater treatment filter presses.

Suggested Text Correction: Delete the underlined section of the statement.

(31) [III-43] Incorrect Statement: The units manage a combined annual volume of approximately 100 tons per year of mercury-contaminated carbon filter material (K106 waste) which are transferred to the Mercury Retort Unit (SWMU 9) for treatment.

Suggested Text Correction. Substitute 5 tons per year for 100 tons per year.

(32) [III-44] Incorrect Waste Classification: The unit manages approximately 5 tons per year of F001 waste (spent solvents and/or solvent bottoms).

Suggested Text Correction: The unit manages approximately 5 tons per year of U211 and D019 waste (offspec carbon tetrachloride).

(33) [III-44] Incorrect Waste Classification: Prior to 1980, F001 wastes generated at this unit were discharged to the Industrial Sewer System (SWMU 14).

Suggested Text Correction: Substitute U211 and D019 wastes for F001 wastes.

(34) [III-48] Incorrect Waste Listing: F001, K106 (wastewater pit sludge) and K071 (saturator sludge and backwash sludge) were also stored at Storage Area B.

Suggested Text Correction: Delete F001.

(35) [III-48] Incorrect Recommendations Selection:

No Further Action (*)
Confirmatory Sampling ( )
RFI Necessary ( )

Suggested Text Correction:

No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

(36) [IV-4] Incorrect Table IV-2 Listing:

Landfill (SWMU 1)
*
*
Old East Ditch (AOC D)

Comment. The SWMU 16 description found on page III-38 recommends "RFI Necessary (*)".

Suggested Text Correction: Add NPDES Outfall Ditch (SWMU 16) to Table IV-3.

(37) [IV-5] Incorrect Table IV-3 Listing:

Brine Filter Backwash Collection Tank (SWMU 5)
*
*
*
NPDES Outfall Ditch (SWMU 16)

Comment. The SWMU 16 description found on page III-38 recommends "RFI Necessary (*)".

Suggested Text Correction: Delete NPDES Outfall Ditch (SWMU 16) from Table IV-3 listing.

ATTACHMENT 2

RFA REPORT TEXT

OCCIDENTAL CHEMICAL CORPORATION

MUSCLE SHOALS FACILITY

MUSCLE SHOALS, ALABAMA

EPA ID ALD 004 019 642

agreement between Region IV EPA and OxyChem, confirmatory sampling will not be conducted as part of the RFA. Instead, conclusions reached during the RFA will be incorporated into the RCRA Facility Investigation (RFI). Consequently, only two courses of action were considered for recommendation in this RFA: a RFI or no further action. The units listed below have been designated for participation in the RFI:

- Landfill (SWMU 1)
- Former South Impounding Basin (SWMU 2)
- Former North Impounding Basin (SWMU 3)
- Salt Storage Piles (SWMU 4)
- Sludge Pads (SWMU 6)
- Mercury Cell Room Trench System (SWMU 7)
- Former Hypalon-Lined Storage Tank Location (SWMU 8)
- Mercury Collection Vessel (SWMU 10)
- Scrubber Solution Treatment Tank (SWMU 13)
- Industrial Sewer System (SWMU 14)
- Old East Outfall Ditch (SWMU 15)
- Southern Stormwater Discharge Ditch (SWMU 23)
- Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24)
- Waste Pile Storage Areas (SWMU 25)
- Junkyard (AOC A)
- Old TVA Pipeline Right-of-Way (AOC B)
- Gravel Covered Area Adjacent to Electric Substation (AOC C)
- Old East Ditch (AOC D)

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No further action is suggested for the remaining units, provided the facility remains in compliance with the applicable permits. As an interim measure, it is suggested that the facility immediately discontinue the practice of releasing wastewater from the Mercury Collection Vessel (SWMU 10) to the Industrial Sewer System (SWMU 14). There should also be an evaluation of an offsite area (Pond Creek) because it has historically received wastewaters with high mercury concentrations from the facility. Refer to the Executive Summary Table for a synopsis of the facility SWMUs and AOCs.

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facility have agreed to eliminate the confirmatory sampling step and proceed directly to the RCRA Facility Investigation (RFI). Consequently, only a RFI or no further action was suggested in this RFA. The units listed below have been designated for participation in the RFI:

- Landfill (SWMU 1)
- Former South Impounding Basin (SWMU 2)
- Former North Impounding Basin (SWMU 3)
- Salt Storage Piles (SWMU 4)
- Sludge Pads (SWMU 6)
- Mercury Cell Room Trench System (SWMU 7)
- Former Hypalon-Lined Storage Tank Location (SWMU 8)
- Mercury Collection Vessel (SWMU 10)
- Scrubber Solution Treatment Tank (SWMU 13)
- Industrial Sewer System (SWMU 14)
- Old East Outfall Ditch (SWMU 15)
- Southern Stormwater Discharge Ditch (SWMU 23)
- Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24)
- Waste Pile Storage Areas (SWMU 25)
- Junkyard (AOC A)
- Old TVA Pipeline Right-of-Way (AOC B)
- Gravel Areas Adjacent to Electric Substation (AOC C)
- Old East Ditch (AOC D)

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No further action is suggested for the remaining units, provided the facility remains in compliance with the applicable permits. An interim measure, it is suggested that the facility immediately discontinue the practice of releasing wastewater from the Mercury Collection Vessel (SWMU 10) to the Industrial Sewer System (SWMU 14).

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It is apparent from the facility-wide nature of the contamination, that the entire facility should be considered in the RFI. In some cases, past investigations have documented the existence but not the full extent of contamination. It should be a central premise of the RFI that both the horizontal and lateral extent of contamination will be fully defined. The facility should also remediate the existing contamination and deal effectively with the sources of continuing release(s) to the environment.

An evaluation of an offsite area (Pond Creek) has also been suggested because it has historically received facility wastewaters with high mercury concentrations. Sediment samples should be collected at designated intervals along its length and

TABLE I-1.
OCCIDENTAL CHEMICAL CORPORATION
EXECUTIVE SUMMARY TABLE.

	SWMU/AOC	Type of unit	Years in operation	Wastes managed[a]	Pollution migration pathways[b]	Evidence of releases	Exposure potential[c]	Recommendation: RFI	Recommendation: No further action
1	Landfill	landfill	1955–1980	A, B, C, D, E	A, SW, S, GW, SS	yes	U	X	
2	Former South Impounding Basin	surface impoundment	1970–1976	E	A, SW, S, GW, SS	yes	U	X	
3	Former North Impounding Basin	surface impoundment	1970–1971	E, F, G	SW, S, GW	yes	U	X	
4	Salt Storage Piles	bulk product storage	1953–1991		S, GW	yes	L	X	
5	Brine Filter Backwash Collection Tank	tank	1990–present	A		no	L		X
6	Sludge Pads	waste storage area	1953–present	B	S, GW	no	U	X	
7	Mercury Cell Room Trench System	trenches/sump	1953–present	E	S, GW	yes	U	X	
8	Former Hypalon-Lined Storage Tank Location	tank	1976–1981	E, G		no	L	X	
9	Mercury Retort Tanks	tanks	1988–present	C, D		no	L		X
10	Mercury Collection Vessel	tanks	1988–present	E	S, GW	yes	U	X	
11	Hazardous Waste Roll-Off Pad	storage pad	1985–present	A, C, K, M		no	L		X
12	Emergency Chlorine Scrubber Tanks	tanks	1974–present	I		no	L		X
13	Scrubber Solution Treatment Tanks	tanks	1974–present	J	SW, S	no	L	X	
14	Industrial Sewer System	sewer system	1953–present	E, F, G	A, SW, S, GW, SS	no	U	X	
15	Old East Outfall Ditch	ditch	1953–present	E, F, G, S	SW, S, GW	no	U	X	
16	NPDES Outfall Ditch	ditch	1971–present	E, F, G, S	SW, S, GW	no	L		X
17	Wastewater Treatment Frame Filter Presses	filters	1974–present	A, K		no	L		X
18	Former PCB Storage Area	temporary storage	1980–1987	L		no	L		X
19	500,000-gallon Wastewater Storage Tank	tank	1981–present	E, G		no	L		X
20	Wastewater Treatment Hydrazine Reaction Tank	tank	1974–present	E		no	L		X
21	Wastewater Treatment Carbon Polishing Towers	tank	1974–present	F		no	L		X
22	Carbon Tetrachloride Stripper	tank	1956–present	N		no	L		X
23	Southern Stormwater Discharge Ditch	ditch	unknown–present	G, P	SW, S, GW	yes	U	X	
24	Stressed Vegetation Area South of Former South Impounding Basin	discharge area	unknown–present	G, P	SW, S, GW	yes	U	X	
25	Waste Pile Storage Areas	waste piles	1980–1984	A, C, D, H, K, M, N, O	S, GW	no	U	X	
A	Junkyard	storage area	unknown–present	O	SW, S	no	L	X	
B	Old TVA Pipeline Right-of-Way	right-of-way	unknown–present		SW, S	no	L	X	
C	Gravel Areas Adjacent to Electrical Substation	surface spill	unknown–present	Q	SW, S, GW	no	L	X	
D	Old East Ditch	earthen ditch	unknown	E, F, G, R	SW, S, GW	yes	U	X	

a A = brine sludges (K071); B = saturator precipitates; C = assorted carbon filter packs/cakes; D = industrial wastewater sump sludges; E = untreated wastewaters; F = treated wastewaters; O = stormwater runoff; H = used motor oil; I = sodium hypochlorite; J = treated scrubber solution; K = wastewater treatment sludges (K106); L = PCB-containing oils and debris from SCP spills; M = D009 waste; N = F001 waste; O = used equipment; P = excess brines; Q = unidentified spilled materials; R = leachate seeping from the landfill; S = washwater from tank cars, barge tanks, and chlorine storage tanks.

b GW = groundwater; SW = surface water; S = soil, A = air; SS = subsurface gas.

c L designates a low, M designates a moderate, H designates a high, and U designates an unknown exposure potential; see SWMU description for substantiation.

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the entrapment of mercury in the brine sludge materials.
Aggregated brine impurities are periodically backwashed from the
Brine Filters and combined with the coarser clarifier tank
precipitates. The sludge materials are then passed through the
Wastewater Treatment Frame Filter Presses (SWMU 17) for
6 dewatering. Since the saturation and clarification steps utilize
contact process brine waters recycled from the cell room, the
brine sludge is contaminated with mercury at an average
7 concentration of 10 ppb (according to facility personnel).
Precipitate also accumulates in the bottom of the Brine Saturator
Tanks. These brine sludges are stored in covered rolloffs and
drums at the Hazardous Waste Roll-Off Pad (SWMU 11) prior to
being shipped to a RCRA permitted landfill facility.

The removal of residual mercury to obtain purified product materials is accomplished by means of carbon adsorption. The facility generates mercury-laden carbon materials from several sources. The potassium-mercury amalgam decomposition step is performed in the decomposer tanks. These tanks are therefore the primary mercury recovery units. Residual mercury is also removed from KOH by carbon-adsorption in Funda and Adams filter units. Hydrogen gas is purified of residual mercury in hydrogen adsorber units, which are also carbon-filter units.

Mercury-laden carbon materials from the carbon filtration units
discussed above are transferred to the Mercury Retort Tanks (SWMU
9). The Retort units use furnace-generated heat to volatilize
mercury from the carbon materials. The mercury vapor is condensed
in a water scrubber and piped to the adjacent Mercury Collection
Vessel (SWMU 10), from which it is recycled back to the
electrolytic production process. The retorted carbon materials
contain residual quantities of nonrecoverable mercury and are
8 classified as K106 waste. All such wastes are transferred to
short-term storage at the facility Hazardous Waste Roll-Off Pad
(SWMU 11) for subsequent disposal at ~~a~~ the hazardous waste
landfill at Emelle, Alabama.

Mercury wastewaters are generated in the mercury cell room from two sources: purging of water used as vapor seals on electrolytic cell endboxes; and wash downs of the cell building as required by National Emission Standards for Hazardous Air Pollutants (NESHAPS) regulations. These waste streams are routed to the facility wastewater treatment plant (WWTP) directly or after temporary storage in a 500,000-gallon Wastewater Storage Tank (SWMU 19). Purged vapor seal waters are routed by pipe to storage or treatment. Cell room wash down waters flow to the Mercury Cell Room Trench System (SWMU 7), are collected at the cell room sump, and are then transferred by pipe to either storage or treatment. Additional mercury-bearing waste streams generated by rain or wash down in the brine and caustic filtration process areas of the facility are collected in the Industrial Sewer System (SWMU

9 14) and routed for treatment or temporary storage. The Industrial Sewer is shown in Figure II-2.

The facility WWTP has been in operation since 1974. Mercury-contaminated wastewaters are directed to a Hydrazine Reaction Tank (SWMU 20) where hydrazine, a reducing agent, is added to precipitate mercury to a filterable form. According to facility personnel the hydrazine used in the treatment process is readily degradable to nitrogen and hydrogen and is not detected as a waste constituent. Hydrazine-treated wastewaters are then passed through the Wastewater Treatment Frame Filter Presses (SWMU 17) for collection of wastewater treatment sludge. The filtered effluent is then passed through Carbon Polishing Towers (SWMU 21) for final polishing before discharge via the Industrial Sewer System (SWMU 14) to the facility's NPDES Outfall Ditch (SWMU 16). These treated wastewaters are routinely monitored for pH, chlorides and mercury according to the requirements of the
10 facility's NPDES permit (Reference 40).

The primary liquefaction of chlorine gas is an efficient process which does not generate significant quantities of waste. The freon used in the chlorine liquefaction system is recovered and recirculated in a closed-loop system. Sulfuric acid used in the dewatering of chlorine is recovered and sold as dilute acid. Residual impurities accumulating in the chlorine drying towers are emptied from the tower. Although facility personnel were unable to characterize or quantify the waste materials removed from the drying towers, they stated that such materials were generated only in insignificant quantities, and that the removal of such residual materials occurred only on an infrequent and
11 irregular basis (i.e., every few years). Any such wastes removed from those process units are sent for disposal at a RCRA-permitted landfill.

Secondary recovery of chlorine vapors generates significant quantities of a hazardous waste (F001 - spent halogenated
12 solvents and/or still bottoms from such solvents). The recovery system collects chlorine gas from a number of sources, including off-gas from the primary liquification process, gas from returned chlorine tank cars, residual gas from weigh tanks, and gas from the OxyChem dock area on the Tennessee River. The collected gaseous chlorine is pressurized, chilled and transferred to the Carbon Tetrachloride Stripper Unit (SWMU 22), where the chlorine
13 is solubilized by carbon tetrachloride (CH_4Cl_2). This Stripper, which is a packed distillation unit, differentially volatilizes and recondenses the solvent-solute mixture to purify and recover the chlorine gas. Accumulated wastes (F001 waste, distillation solvent and still bottoms) are removed from the unit during
14 routine maintenance operations. All such collected wastes are stored at the facility's Hazardous Waste Roll-off Pad (SWMU 11) until shipment to a permitted disposal facility.

processes have reportedly been shipped offsite for disposal. However, the facility still possesses a junkyard area used for long-term storage of defunct equipment (AOC A) and an area in the Former North Impounding Basin (SWMU 3) just north of the junkyard where there were piles of both excavated soil (from elsewhere in the plant) and some construction debris at the time of the VSI.

Management of facility wastewaters has varied over the years as the facility gradually adapted its management practices in response to regulatory requirements. From 1953 to 1969, untreated facility wastewaters and noncontact process waters were routed through the Industrial Sewer System (SWMU 14) directly to the Old East Outfall Ditch (SWMU 15) and the Original Pond Creek Tributary. The tributary was also the primary receptor for facility stormwater runoff. The original bed for the tributary is shown in the site plan (Figure II-3) and a schematic diagram of facility sewer lines discharging to facility surface drainage areas is shown in Figure II-2, see page II-8.

15 This tributary stream formerly flowed roughly east to west and was centrally located in the area eventually occupied by the Former North Impounding Basin (SWMU 3). According to facility personnel, mercury concentrations in wastewaters generated during that period are believed to have averaged approximately two ppm.

In 1970, a dam was constructed across the original Pond Creek tributary near the northwestern facility boundary and immediately east of Wilson Dam Road. The construction of the dam, which is currently still in existence, resulted in the creation of a surface impoundment identified as the North Impounding Basin (SWMU 3). From 1970 to 1971, the facility discharged waters from the North Impounding Basin to the downgradient end of the tributary below the dam. Discharge of those waters was reportedly done on a metered basis to comply with applicable discharge limits for mercury.

In 1971, the facility constructed a new outfall ditch south of the North Impounding Basin (SWMU 3). This ditch is identified as the NPDES Outfall Ditch (SWMU 16). At that time, the Old Pond Creek Tributary was routed to the north of the North Impounding Basin (see the site plan in Figure II-3). Following the construction of the NPDES Outfall Ditch, the diverted tributary and the North Impounding Basin were isolated from routine exposure to facility wastewaters. The NPDES Outfall Ditch has been in continuous operation since its construction in 1971.

The facility constructed a second surface impoundment south of the mercury cell room building in 1970. That unit was identified as the South Impounding Basin (SWMU 2). From 1970 to 1974, the unit was used for the treatment and storage of plant process wastewaters, which were subsequently released to the NPDES

These site investigations are briefly described below:

1. In 1980 and 1981, Woodward-Clyde Consultants, Inc. conducted studies to determine the quality and direction of groundwater flow, evaluate the thickness and effectiveness of the landfill cover, and examine surface soils and sediments for contamination. Data from the studies were used to upgrade the landfill cover and to support the contention that the North Impounding Basin (SWMU 3) posed no harm to the environment.

2. In 1987, Dames and Moore evaluated the role of the landfill as a source of contamination. This study documented mercury and chloride contamination of groundwater.

3. In 1987, G&E Engineering, Inc. began a series of site investigations to evaluate contamination of soils, sediments, surface water and groundwater. In addition, the landfill cover was upgraded and recommendations were made for no remediation of existing site contamination.

16 The study conducted by G&E revealed the presence of elevated levels of mercury, cadmium and chlorides in the underlying groundwaters of the Tuscumbia/Fort Payne aquifer, which is regionally utilized as a potable water source. Groundwater samples obtained between October 1988 and January 1989 revealed contaminant levels as high as 93,500 ppm chloride, 340 ppb mercury, and 330 ppb cadmium (Reference 10).

2. RCRA and Closure Activities

The facility submitted its initial RCRA Part A Hazardous Waste Permit Application on November 18, 1980 (Reference 29). The facility formally withdrew its Part A Application on October 22, 1984, instead electing to close all long-term storage areas with the intent of being classified solely as a hazardous waste generator (Reference 30). In pursuit of that goal, the facility obtained certified closure from ADEM for Waste Piles A and B, (SWMU 25) on June 2, 1986 (Reference 27). EPA Region IV and the State of Alabama have requested that the facility submit a Part B Hazardous Waste Post-Closure Permit Application for closed Waste Pile B (Reference 31).

On August 27, 1990, ADEM issued a Notice of Violation to the Muscle Shoals Plant (Reference 15), as specified under Title 22 of the Code of Alabama. The Notice of Violation was issued on the basis of groundwater monitoring analytical results obtained during site investigation activities initiated by G&E Engineering in 1987. As a result, the facility is now under a compliance

East to west geologic cross sections exhibiting the site specific subsurface stratigraphy at the facility are presented in Figure II-6.

As part of 1988 site assessment activities (Reference 10) soil samples were collected from locations across the facility. Sample analyses for mercury and chlorides yielded soil sample concentrations ranging from less than 0.02 to 200 mg/kg, and 5 to 43,500 mg/kg, respectively (Figures II-7 and II-8).

4. Groundwater

Groundwater is present in both the unconsolidated overburden (regolith), and in the consolidated limestone bedrock underlying the Occidental Chemical facility. Although these two intervals constitute the two uppermost aquifers in the region, groundwater has been monitored in previous studies from three distinct zones within these aquifers. These include the Upper Zone, which includes the regolith, the Lower Zone, which includes the upper 5 to 10 feet of the Tuscumbia Limestone bedrock, and the Deep Zone, which includes Tuscumbia Limestone bedrock intervals located deeper than 35 ft from the top of the unit. The remainder of this discussion will revolve around the three zones rather than on specific aquifers (Reference 10).

The hydrological characteristics of the Upper and Lower Zones differs as a result of the lithological differences between the units. Groundwater occurs in the regolith, or Upper Zone, under unconfined conditions. Depth to the water table at the facility ranges from 5 to 25 ft, depending upon the season and location of the well. Recharge to the unit occurs from surface infiltration. Although the direction of groundwater flow in the Upper Zone generally conforms with the surface topography, a pronounced groundwater mound is present underneath the facility process area (Figure II-7). This mound is believed to be a result of direct infiltration from the nearly continuously filled drainage ditch system, and the absence of vegetation (Reference 10). At the facility, groundwater flows outward in a radial pattern from the process area. The regional groundwater flow patterns in the Upper Zone are to the north and west towards the Tennessee River. Field derived hydraulic conductivity values for the Upper Zone range from 9.6×10^{-4} to 1.0×10^{-5} centimeters per second (cm/sec). The Upper Zone hydraulic gradient ranges from 0.003 to 0.01 ft per ft (ft/ft), while the calculated groundwater flow velocity ranges from 1.2 to 400 ft per year (ft/year) (Reference 10).

17

Groundwater also occurs under unconfined conditions in the upper intervals of the Tuscumbia Limestone bedrock, or Lower Zone. Since the Upper and Lower Zones are not separated by a confining unit, they are in direct hydraulic communication. Recharge to the Lower Zone is through downward infiltration from the overlying

Monitor wells and piezometers were installed at the facility beginning in 1980, subsequent to a request by ADEM that four monitor wells be installed around the landfill (Reference 45). By September 1980, 4 observation wells (OW-1 through OW-4) and 27 piezometers (P1 through P27) had been installed at the facility. Nineteen borings were advanced through the landfill cap in November 1980 to determine the permeability and geotechnical properties of the landfill cap materials. By March 1981, 21 additional observation wells (OW-5 through OW-24; including 2 wells at one location, OW-15A and OW-15B) had been installed at the plant site, bringing the total number of wells to 25. In 1988, 10 of the 25 wells were plugged and abandoned as a result of poor construction; however; 8 were re-drilled and completed as replacement wells. In addition, 34 soil borings were drilled at various locations across the facility property for soil characterization and laboratory analyses. Upon completion of the sampling activities, the borings were completed as Lower Zone monitor wells, bringing the total number of wells to 57. In addition to the wells, 21 of the 27 piezometers were abandoned. The six remaining piezometers were not abandoned because they either could not be located or were inaccessible. Five water supply wells are also present at the facility. Of these wells, one is closed, one is partially closed, two are inactive, and one is active only for purposes of water level measurement in the Deep aquifer. A detailed discussion of the current status and closure procedures of the water supply wells is presented in Reference 10.

In 1990, a supplemental hydrogeological study was conducted at the facility to better define the hydrogeologic relationship between the regolith and fractured limestone unit. Three additional monitor wells (DOW-4, DOW-5, and DOW-6) were installed to monitor the limestone Deep Zone. In addition, one Upper Zone monitor well (OW-43) was abandoned (Reference 1).

In October 1988, Occidental collected and analyzed two groundwater samples (OW-14A and OW-27) for 40 CFR 264 Appendix IX constituents. The analyses indicated the presence of mercury, cadmium, and chloride in concentrations exceeding the drinking water standards. In response, Occidental began submitting additional groundwater samples from locations across the facility 18 for Appendix IX analyses. The results indicated that the groundwater underlying the facility was contaminated with mercury (Reference 10) (in concentrations ranging from <0.2 ppb to 340 ppb), cadmium (ranging from <5 ppb to 340 ppb), and chloride (ranging from <1 ppm to 170,000 ppm) (References 1 and 10). Figures II-14 through II-18 are isoconcentration contour maps which show the concentrations of the contaminants in the Upper and Lower Zones for the sampling period September 1989 to October 1990. In addition, Figure II-19 is an east to west geologic cross section which shows the vertical distribution of contaminants in

SWMU NUMBER: 9 **PHOTOGRAPH NO.:** 9.1

NAME: Mercury Retort Tanks (2)

TYPE OF UNIT: Tanks

PERIOD OF OPERATION: 1988-Present

PHYSICAL DESCRIPTION AND CONDITION: The abovegrade steel tanks have an apparent capacity of greater than 100 gallons and are high temperature retort furnaces used for the recovery of mercury from the various waste streams listed below. The recovered mercury and some mercury contaminated wastewater are discharged directly to the Mercury Collection Vessel (SWMU 10). The units, which are situated on a concrete pad, are located approximately 100 feet west of the mercury cell room building, approximately 70 feet south of the northwest corner of the building.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The following waste materials are treated at the unit:

Funda and Adams filter cake
H_2 Adsorber carbon
Decomposer graphite
Waste water treatment filter cake
Waste water treatment carbon tower material
Mercury cell room trench sludges
Contaminated soils

19 An approximate volume of 200 tons per year of retorted carbon materials (K106) are generated at the unit. The primary emissions of the unit are combustion by-products (noncontact) and water vapor (Reference 35).

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 28, 35, 36, 37, 38, 43

COMMENTS: None

SWMU NUMBER: 10 **PHOTOGRAPH NO.:** 10.1-10.2

NAME: Mercury Collection Vessel

TYPE OF UNIT: Tank

PERIOD OF OPERATION: 1988-Present

PHYSICAL DESCRIPTION AND CONDITION: This abovegrade steel tank is located in an outdoors area adjacent to the Mercury Retort Tanks (SWMU 9), approximately 70 feet west of the mercury cell room building and approximately 70 feet south of the northwest corner of the building. The tank accumulates mercury recovered from waste materials subjected to retort in the Mercury Retort Tanks (SWMU 9).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Visual observations made at the time of the VSI suggested that there is routine release of mercury or mercury-contaminated wastewaters to the surrounding concrete and to the adjacent inlet to the Industrial Sewer System, SWMU 14 (see Photographs 10.1 and 10.2, Appendix B). 20

RELEASE PATHWAYS: Air (U)* Surface Water (U)* Soil (U) Groundwater (U)* Subsurface Gas (U)*

HISTORY AND/OR EVIDENCE OF RELEASES(S): Visual observations made at the time of the VSI indicated that this tank may periodically release mercury or mercury-contaminated wastewaters to the Industrial Sewer System (SWMU 14) which in turn discharges to the NPDES Outfall Ditch (SWMU 16). 21 Stained concrete was observed adjacent to the unit from the point at which a water purge line emptied from the tank (see Photograph 10.2, Appendix B). The stained surface extended for several feet to a sewer drain. A second area of stained concrete was observed nearby, apparently as the result of spillage or overflow during transfer of mercury from the collection vessel to an adjacent transfer container box (see right foreground of Photograph 10.1, Appendix B). The drainage pathway of this second release source, as revealed by concrete staining, followed the general slope of the concrete surface and was observed to gradually diffuse until no longer visible. It is likely that hazardous constituents potentially released at the transfer box would also be likely to drain into the Industrial Sewer System (SWMU 14) at other inlet points. 22

RECOMMENDATIONS: No Further Action ( )
Confirmation Sampling ( )
RFI Necessary (*)

REFERENCE: None

COMMENTS: As part of the RFI, it is suggested that the facility analyze the water contained in these vessels as an indication of the quantity of mercury that has been released by the unit. Furthermore, as an interim measure, the practice of uncontrolled release of mercury wastewaters to the surrounding area and the Industrial Sewer System (SWMU 14) should be stopped immediately and the area should be decontaminated.

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*The release potentials for the air, surface water, soil, groundwater and subsurface gas pathways were listed as unknown because it was either not possible to quantify the probable releases or there was no information available on the potential for mercury vapors to migrate through soil in the vapor phase.

SWMU NUMBER: 12 **PHOTOGRAPH NO.:** 12.1-12.2

NAME: Emergency Chlorine Scrubber Tanks (2)

TYPE OF UNIT: Tanks

PERIOD OF OPERATION: 1974-Present

PHYSICAL DESCRIPTION AND CONDITION: The two 55,000-gallon steel tanks receive discarded chlorine product directed to the unit as needed on an emergency basis. The units are situated on an abovegrade concrete structure that is partially surrounded by approximately 6-inch high concrete curbing. The tanks are located approximately 450 feet east and 450 feet south of the southeast corner of the mercury cell room building.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Waste chlorine piped to the unit is mixed with 20% sodium hydroxide (NaOH) in the scrubber tanks to produce sodium hypochlorite (NaOCl, i.e., bleach). Upon depletion of the NaOH, the scrubber solution is piped to the adjacent Scrubber Solution Treatment Tank (SWMU 13). The unit generates approximately 15 tons of waste per year. This waste is suspected to be hazardous, based on the characteristic of corrosivity (D003).

24

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 28

COMMENTS: The facility should determine if this waste is correctly classified as corrosive hazardous waste (D003).

SWMU NUMBER: 14 **PHOTOGRAPH NO.:** 14.1-14.6

NAME: Industrial Sewer System

25 **PERIOD OF OPERATION:** 1951-Present

PHYSICAL DESCRIPTION AND CONDITION: The Oxychem facility was built during 1952 to 1953, and most of the sewer lines (constructed of reinforced concrete) were installed during construction of the plant (Figure III-6) and are still in use. Various new lines constructed of vitrified clay have been added to the system over time and a length of sewer pipe southwest of the Mercury Cell Building and running due east was removed from service in 1976 (see Figure II-2, page II-8). A study of the system conducted in 1989 showed the build-up of insoluble salts in the older sections and some of the newer sections of pipe (Reference 24). No special sealing material was used at the joints of the pipe and therefore seepage occurs at all of these junctions.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Wastewaters received by the sewer system (see Photographs 14.1-14.6, Appendix B) have contained high concentrations of mercury and all other contaminants in the liquids that either entered the Mercury Cell Room Trench System (SWMU 7), other drains to the Industrial Sewer System, or stormwater runoff from the plant. Prior to 1980, unknown quantities of F001 wastes (spent carbon tetrachloride solvents and still bottoms) generated at the Carbon Tetrachloride
26 Stripper (SWMU 22) were also discharged to this unit.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (H) Groundwater (H) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): While the sewers have not been specifically linked to the general contamination of soil and groundwater adjacent to the sewers, they have conveyed contaminated water through unsealed pipes and have contributed to the contamination beyond the points at which the sewers discharge to area drainage ditches (see Photographs 14.3 and 14.6, Appendix B).

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 10, 18, 24

COMMENTS: There should be an assessment of past and present wastes disposed in the sewers. As an interim measure, the discharge from the Mercury Collection Vessel (SWMU 10) is an example of a continuing release of mercury contaminated waters entering the sewer system which should cease immediately. The RFI should define the extent of contamination under and immediately adjacent to the sewers to determine to what degree they have contributed to and continue to contribute to the contamination underlying the area.

27

SWMU NUMBER: 17 **PHOTOGRAPH NO.:** 17.1-17.2

NAME: Wastewater Treatment Frame Filter Presses

TYPE OF UNIT: Plate and frame filters

PERIOD OF OPERATION: 1974-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit consists of three plate and frame filter systems. Two of the units operate in parallel while the third unit is idle or under repair. These presses, which filter K071 brine sludges piped from the Brine Clarifier Tanks (SWMU 5), are located in the vicinity of the
28 wastewater treatment facility. Filtrate brine liquids passing through the filter units are returned to the electrolytic process.

These in-line filter units are part of the wastewater treatment system and are located outdoors approximately 50 feet from the remaining wastewater treatment units. KCl sludge materials generated at the unit are accumulated in subtending hoppers prior
29 to transfer to the Mercury Retort Tanks (SWMU 9).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The frame and filter presses manage approximately 150 tons per year of wastewater treatment sludges (K106) and 600 tons per year of
30 brine sludge (K071).

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 28, 36, 38, 39

COMMENTS: None

SWMU NUMBER: 21 **PHOTOGRAPH NO.:** Unit Not Located

NAME: Wastewater Treatment Carbon Polishing Towers (3)

TYPE OF UNIT: Tank

PERIOD OF OPERATION: 1974-Present

PHYSICAL DESCRIPTION AND CONDITION: These three abovegrade steel tanks (one 14 feet by 42 inches and two 15 feet by 42 inches) are located in an enclosed area in the wastewater treatment area of the facility. The units provide a final carbon-filtration polishing to treated wastewaters prior to release to the facility Industrial Sewer System (SWMU 14) and subsequently to the NPDES Outfall Ditch (SWMU 16).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The units manage a combined annual volume of approximately 100 tons per year of mercury-contaminated carbon filter material (K106 waste) which are transferred to the Mercury Retort Unit (SWMU 9) for
31 treatment.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 38, 39

COMMENTS: None

SWMU NUMBER: 22 **PHOTOGRAPH NO.:** Unit Not Located

NAME: Carbon Tetrachloride Stripper

TYPE OF UNIT: Tank

PERIOD OF OPERATION: 1956-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit consists of a tank measuring 3 feet in diameter by 56 feet high. The unit was not viewed at the time of the VSI. The tank is located in the northeast corner of the mercury cell room building. The unit is situated on a concrete pad with a surrounding trench and sump collection system. It recovers chlorine collected from various process sources.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The unit manages approximately 5 tons per year of F001 waste (spent solvents (32) and/or solvent bottoms). According to facility personnel, accumulated wastes are removed from the unit during routine maintenance operations and ultimately disposed of at the hazardous waste landfill in Emelle, Alabama.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 38, 39, 42

COMMENTS: Prior to 1980, F001 wastes generated at this unit were discharged to the Industrial Sewer (33) System (SWMU 14).

SWMU NUMBER: 25 **PHOTOGRAPH NO.:** 25.1

NAME: Waste Pile Storage Areas

TYPE OF UNIT: Waste Piles

PERIOD OF OPERATION: 1980-1984

PHYSICAL DESCRIPTION AND CONDITION: Storage Area A consists of a 3-inch layer of asphalt on top of a 6-inch layer of lime treated subgrade surrounded by a 6-inch asphalt curb. Surface water was diverted by means of a slope to a sump, which routed the wastewater to the wastewater treatment system.

Storage Area B consists of a 4-inch layer of shotcrete placed over 8 inches of reinforced concrete. The unit has a back wall approximately 6 feet tall to minimize the potential for wind dispersal of waste. The unit is still in service and is further described as the Hazardous Waste Roll-Off Pad (SWMU 11).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Storage Area A stored contaminated equipment and a variety of drummed waste including spent filter cakes, spent carbon, waste solvents, cell butter and used motor oil. Storage Area B stored bulk (uncontainerized) hazardous wastes and drummed waste. F001, K106 (wastewater pit sludge) and K071 (saturator sludge and backwash
34 sludge) were also stored at Storage Area B.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): Both storage areas were certified as closed by ADEM, and there were no records of releases prior to that time. Storage Area B is now used for 90-day storage of waste (the Hazardous Waste Roll-Off Pad, SWMU 11).

35 **RECOMMENDATIONS:** No Further Action (*)
Confirmatory Sampling ( )
RFI Necessary ( )

Table IV-2
List of SWMUs and AOCs that Require a RFI

Landfill (SWMU 1)
Former South Impounding Basin (SWMU 2)
Former North Impounding Basin (SWMU 3)
Salt Storage Piles (SWMU 4)
Sludge Pads (SWMU 6)
Mercury Cell Room Trench System (SWMU 7)
Former Hypalon-Lined Storage Tank Location (SWMU 8)
Mercury Collection Vessel (SWMU 10)
Scrubber Solution Treatment Tank (SWMU 13)
Industrial Sewer System (SWMU 14)
Old East Outfall Ditch (SWMU 15)
Southern Stormwater Discharge Ditch (SWMU 23)
Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24)
Waste Pile Storage Areas (SWMU 25)
Junkyard (AOC A)
Old TVA Pipeline Right-of-Way (AOC B)
Gravel Areas Adjacent to Electric Substation (AOC C)
36 Old East Ditch (AOC D)

Table IV-3
List of SWMUs and AOCs Requiring No Further Action at This Time

Brine Filter Backwash Collection Tank (SWMU 5)
Mercury Retort Tanks (SWMU 9)
Hazardous Waste Roll-Off Pad (SWMU 11)
Emergency Chlorine Scrubber Tanks (SWMU 12)
37 NPDES Outfall Ditch (SWMU 16)
Wastewater Treatment Frame Filter Presses (SWMU 17)
Former PCB Storage Area (SWMU 18)
500,000-gallon Wastewater Storage Tank (SWMU 19)
Wastewater Treatment Hydrazine Reaction Tank (SWMU 20)
Wastewater Treatment Carbon Polishing Towers (SWMU 21)
Carbon Tetrachloride Stripper (SWMU 22)

EXHIBIT 1-4

MEMORANDUM ON NOVEMBER 5, 1991

PROJECT STATUS MEETING

G & E ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

P.O. BOX 77510
BATON ROUGE, LOUISIANA 70879-7510

4915 SOUTH SHERWOOD FOREST BOULEVARD
BATON ROUGE, LOUISIANA 70816

(504) 292-9007

December 4, 1991

Mr. Robert Kaczorowski
Project Manager
Occidental Chemical
Corporation (OxyChem)
Box 728
Niagara Falls, NY 14302

Re: Memorandum for Record
November 5, 1991 Project
Status Meeting
Muscle Shoals Facility
Muscle Shoals, Alabama
G&E File: 87-0188

Dear Mr. Kaczorowski:

On November 5, 1991 a project status meeting was conducted at the Muscle Shoals chlor-alkali plant to discuss the requirement to prepare a RCRA post-closure care monitoring permit application in light of 1) the on-going groundwater investigation and 2) the likely need to initiate a RCRA Facility Investigation (RFI) in conjunction with Waste Pile B closed in 1986. The following individuals participated in the meeting:

ADEM: Russell Kelly, Land Division (Engineering Services)
Ayman EL-Husari, Land Division (Engineering Services)
Dennis Hallman, Water Division (Groundwater)

EPA: Pat Anderson, Region IV, RCRA Branch, Waste Management Division (participated via telephone)

OxyChem: Gerry Clarke, Plant Manager
Andy Lampert, Plant Technical Superintendent
Chris Manley, Sr. Plant Environmental Engineer
Vern Heble, Corporate, Special Environmental

G&E Eng.: Richard Adams, Senior Principal
Dan Adams, Principal
Juliette Pierce, Project Manager

The meeting was conducted in three phases: 1) a conference room session (which included Pat Anderson via telephone), 2) a site tour, and 3) a wrap-up session to confirm tasks and schedule. The meeting was a significant milestone in determining the extent of investigation, corrective action, and regulatory agency involvement. In particular the meeting provided a forum for identifying how three separate, but overlapping, regulatory requirements could be addressed with a single investigation and resulting submittal. The balance of this memorandum summarizes the three requirements and then describes the combined response.

<u>ADEM Water Division, Re: Corrective Action Plan</u>. The Groundwater Branch of the Water Division (Dennis Hallman as project coordinator) has been administrating a Notice of Violation forwarded to OxyChem on August 27, 1990 requesting additional assessment efforts and the preparation of a corrective action plan. The additional assessment (dye tracer study and added deep zone wells) has been accomplished and reported to ADEM in an August 1991 report.

The principal remaining task expected by ADEM Water Division is preparation and implementation of a Corrective Action Plan.

<u>EPA/ADEM, Hazardous Waste, Re: Post Closure Part B Application</u>. EPA Region IV is in the process of requesting all facilities with waste management units which were closed under interim RCRA guidelines to 1) petition for a clean closure equivalency determination or 2) submit a Post-Closure Part B Application. At the OxyChem Muscle Shoals facility there are two such units (Waste Pile A and Waste Pile B) closed in 1986 under the interim guidelines. A clean closure equivalency is being sought by OxyChem for Waste Pile A. The Waste Pile B unit is a concrete pad which had served as a staging area for precipitated brine mud. The plant-wide groundwater investigation which has been conducted from 1988 to present has determined that the groundwater beneath this pad has been impacted by mercury, cadmium, and chlorides. Therefore, a RCRA Part B Permit for post-closure monitoring is required for Waste Pile B. ADEM has been delegated review authority for Part B applications by EPA, and Ayman EL-Husari, ADEM Engineering Services Branch, is the project coordinator. Pat Anderson at EPA Region IV is monitoring this action for EPA.

The principal components of the post-closure permit application are:

- Background information (site and regional groundwater information, delineation of impact of contamination, etc.). Much of this information will be drawn from the May 1989 and August 1991 groundwater assessment reports.

- A Groundwater Monitoring Plan.

- A Corrective Action Plan.

- An Alternate Concentration Limit (ACL) Demonstration/Study, if ACLs are to be requested as is the intent of OxyChem.

<u>EPA/ADEM Hazardous Waste, Re: RCRA Facility Assessment (RFA) and RCRA Facility Investigation (RFI)</u>. The administration of Waste Pile B as a RCRA waste unit has resulted in the need for an overall facility assessment within the context of RCRA facility management. Typically, a site will first submit a RCRA Part B Permit application and then an RFA is conducted leading to additional investigation (an RFI). The discussions with the EPA and ADEM representatives surfaced the possibility of expediting the EPA administered RFA so that its recommendations could be incorporated in a RFI Work Plan that could be submitted at the same time as the post-closure monitoring permit application and the corrective action plan for ADEM Groundwater Branch. EPA (Pat Anderson as project coordinator) has the lead for the RFA/RFI process.

The principal components of the RFI Work Plan are:

- Background Information. Much of which will be drawn from the May 1989 and August 1991 groundwater assessment reports.

- Assessment Plan (In view of the extensive nature of the investigation already completed, this plan is envisioned as only addressing a limited number of issues raised by the RFA).

- Corrective Action Plan/Measures (referred to in the RFI process as Corrective Action Study and Interim Corrective Measures).

<u>Combined Response Strategy</u>. A review of the principal components of the responses to the three regulatory requirements reveals a great deal of overlap, and supports the idea that a single submittal could be prepared which meets all three requirements. An

issue raised at the November 5, 1991 meeting was that the schedules associated with the Corrective Action Plan for ADEM Groundwater (submission by January 1992) and the Part B application for post-closure monitoring (due by March 31, 1992) not be significantly impacted by the integration of the RFA/RFI process. EPA indicated they would make every effort to expedite the RFA report preparation in order to minimize delays. It was agreed that if the submission of the Part B application would be delayed beyond March 31, 1992, a written request for extension of the application due date would be provided by OxyChem in a timely manner and an extension would be granted by EPA/ADEM.

Sincerely,
G&E Engineering, Inc.

Daniel E. Adams, PE
Principal

Richard B. Adams, PE, DEE, CGWP
Senior Principal

DEA/RBA:fam

CC: EPA Region IV, Pat Anderson
ADEM, Engineering Services Branch, Ayman EL-Husari
ADEM, Groundwater Branch, Dennis Hallman
OxyChem, Corporate Environmental, Vern Heble
OxyChem, Plant Technical Superintendent, Andy Lampert

EXHIBIT 8-1

LANDFILL UPGRADE CONSTRUCTION STATUS REPORT

G & E ENGINEERING, INC.
CONSULTING ENVIRONMENTAL & GEOTECHNICAL ENGINEERS

P.O. BOX 77510
BATON ROUGE, LOUISIANA 70879-7510

4915 SOUTH SHERWOOD FOREST BOULEVARD
BATON ROUGE, LOUISIANA 70816

(504) 292-9007

September 21, 1990

Mr. Bud Rebstock
Occidental Chemical
Corporation (OxyChem)
Box 728
Niagara Falls, NY 14302

Re: Status Report #3
Landfill Upgrade Project
Muscle Shoals Facility
Muscle Shoals, Alabama
File: 87-0188

Dear Mr. Rebstock:

Please find enclosed a task completion status sheet for the Muscle Shoals landfill upgrade project covering the period through September 19, 1990. The work performed during this period included the completion of all on-site activities except the on-call, contingency watering of the newly planted grass cover. The following comments are provided on specific tasks accomplished since the previous status report.

- The salt impregnated soils were placed and compacted in the zone from the top to the base of the former landfill east perimeter road. Included were the soils described in Additional Work Authorization #809-024-01. The inclusion of the additional soils necessitated modifications to the design contours so that the salt impregnated soils could be placed above the existing ground level. The modified landfill shape fulfills radial drainage requirements of the original design while resulting in a less noticeable telltale shape. The as built drawings will reflect the final contours as determined by survey.

- The cutting and filling requirements were completed with no unusual problems. The borrow material was easily screened for excess chert with only a few pockets of excess chert having been observed.

- The compaction requirements of 90% maximum density at or above optimum moisture were not a problem. The densities and water content were measured by Universal Testing, Inc. of Florence, Alabama. The field density reports are provided as Attachment 1. These data confirm information on the original cap that the locally available soils are suitable for landfill cap use. Of particular interest was the continued dry weather which enabled the contractor to work without constraint in the low area to the east of the landfill. The load bearing capacity of this previously impassable area was increased to a point that it bore the traffic of all the heavy equipment in use at the site. See Exhibit 1 for photographs of the recontoured landfill and Exhibit 2 for details of the compaction process.

- o The surface preparation and installation of the geomembrane were straightforward. The rolled surface was judged smooth enough by both G&E and the geomembrane installer (Environmental Liners, Inc.) to not require a bottom layer of geofabric or other special installation procedures. The photographs on Exhibits 2 and 3 provide views of the installed geomembrane.

- o At the beginning of the project the topsoil on the existing cap was temporarily placed to the north of the construction activities. Additional topsoil was obtained from the surface soils of the borrow area (former cotton field). These soils were distributed over the geomembrane to minimum of 1 foot in depth. Two areas of erosion concern (the north and south edges) were reinforce with sod. The balance of the approximately 10 acres were seeded with a mix of fescue grass and wheat and then fertilized.

- o Miscellaneous finishing tasks included:

    - o Replacing the concrete pads around monitor wells OW-20A, OW-21 and OW-22. These pads had been disturbed during earth moving activities, but inspection by G&E indicated the damage was restricted to the pads.

    - o Contouring the northern edge of the borrow area for both aesthetic and safety reasons. The previous use of the area for borrow resulted in an abrupt ten foot drop at the end of the cotton field.

    - o Regrading the existing east-west ditch to the south of the landfill to insure proper drainage from that feature.

As OxyChem's project/site representative for the landfill upgrade project, G&E accepts the work accomplished by Delta Environmental, Inc. up to this point. The tasks yet to be performed are the establishment of a viable grass cover and the submission of four sets of "as-built" drawings to include the drawings prepared by Environmental Liners Inc. for the geomembrane. It would be appropriate for Delta to submit an invoice and be paid for their efforts with 10% being retained until the grass cover is established and the as-built drawings are provided.

If you have any questions on this status report please call.

Sincerely,

D E Adams

Daniel E. Adams, PE
Project Manager

Richard B. Adams

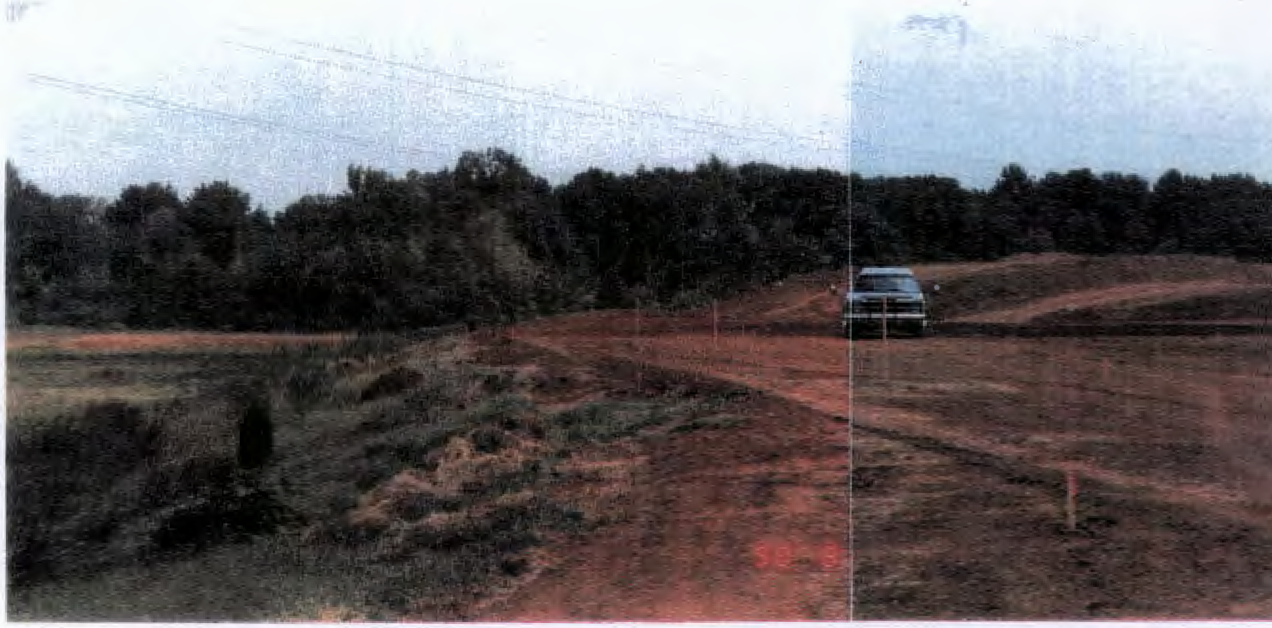
Richard B. Adams, PE, DEE, CGWP
President

DEA/RBA:rad

Enclosures

cc: Mr. Vern Heble
Mr. Andy Lampert
Mr. John Clemente

DIRT BEHIND PICKUP



MAT

CONTOURS FOR INS

(NEARING COMP

PANORAMIC VIEW STANDING ON N

THROUGH SOUTH T

TOCKPILED TOPSOIL

.INE

ATION OF GEOMEMBRANE

ON, AUGUST 23, 1990)

OF LANDFILL LOOKING EAST (UPPER LEFT)

UTHWEST (LOWER RIGHT)

1

EXHIBIT

WATERING TO ACHIEVE REQUIRED MOISTURE CONTENT DURING COMPACTION

(AUGUST 21, 1990)

MIDDLE OF LANDFILL

LANDFILL WITH 3

(SEPT

VIEW LOOKING TO THE NO

SPREADING AND COMPACTION OF LIFTS
(AUGUST 21, 1990)
SOUTHEAST CORNER OF LANDFILL

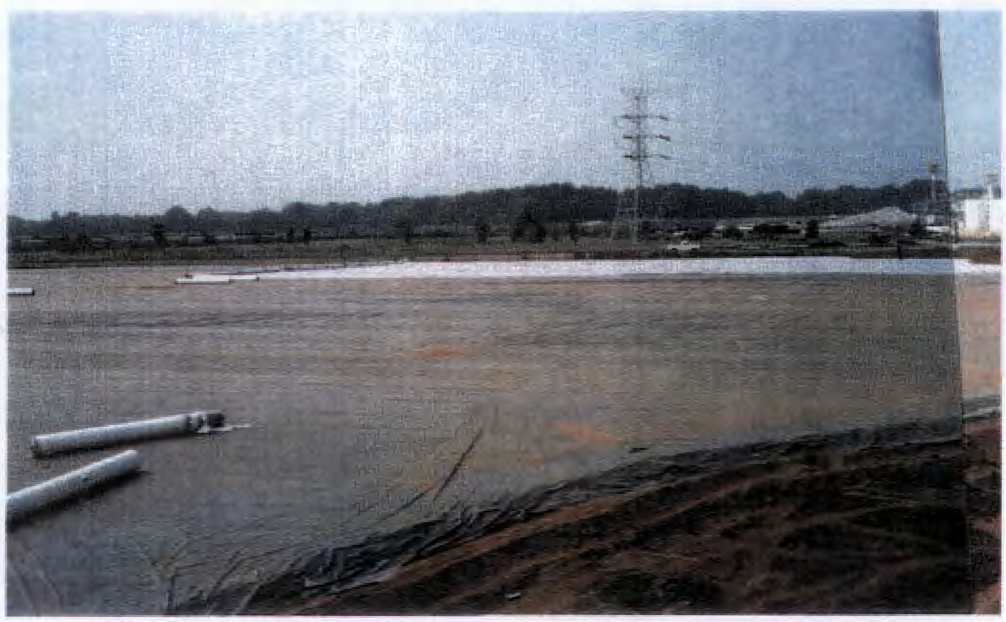
ROUTE OF 10-FOOT DEEP
ANCHORING/BARRIER TRENCH

PVC GEOMEMBRANE
ɪ 5, 1990)
ɪOM THE SOUTHEAST CORNER

2
EXHIBIT

NOTE HEAVY TRAFFIC ON FORMER
MARSH AREA TO THE EAST

MAT



LANDFILL WITH 30

(SEPTEME

PANORAMIC VIEW STANDING ON PILI

THROUGH SOUTH T(

THIS AREA AWAITING FINAL TRIM
AND STRETCH PRIOR TO ANCORING

LINE

ROLLS OF WHITE MATERIAL ARE THE 6 OUNCE GEOFABRIC
TOPSOIL IN PROGRESS OF BEING APPLIED

PVC GEOMEMBRANE
5, 1990)
TOPSOIL LOOKING EAST (UPER LEFT)
EST (LOWER RIGHT)

3
EXHIBIT

Occidental Chemical Corporation

WEEKLY MEETING NO. 8

PROJECT Landfill Improvements DATE 09/19/90

LOCATION Muscle Shoals Alabama NEXT MTG. SCHEDULED

ATTENDANTS:

1. James H Zeigler
2.
3.
4.
5.

CONTRACTOR:

1. R McCollom
2.
3.
4.
5.
6.
7.
8.
9.
10.

WORK SCHEDULE

ITEM NO.	DATE 1990	AREA	DESCRIPTION	COMPLETION % LAST	COMPLETION % THIS
2.2.4.1		Landfill	Survey Lines and Markers	100%	100%
2.2.4.2		" "	Clearing and Stockpiling Topsoil	100%	100%
2.2.4.3		" "	Relocation of Salt Impregnated Soil	100%	100%
2.2.4.4.		" "	Excavation and Fill	100%	100%
2.2.4.5		" "	Placing, Compacting + Testing Fill + Cap	100%	100%
2.3.4.1		Landfill	Surface Preparation for Geomembrane	100%	100%
2.3.4.2		" "	Geomembrane + GeoFabric Installation	100%	100%
2.4.4.1		Landfill	Topsoil Selection	100%	100%
2.4.4.2		" "	Topsoil Distribution	100%	100%
2.4.4.3		" "	Establishment of a Vegetative Cover	0%	80%*
			*Seeding/sodding completed. Now monitoring for growth		

ATTACHMENT 1

FIELD DENSITY REPORTS

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-21-90
Time Arrived: ______

Project: Occidental Chemical - Landfill Closure Job # 69-90-01
Special Instructions: ______
Work Performed: Compaction Testing on Soil Backfill (E of Pre-Existing Landfill)

Test No.	Wet Density pci	Moisture Content %	Dry Density pci	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
1	112.6	22.2	92.2	1	NUC	93	90	West of 10' Trench SE End	-1.5'
2	115.7	24.5	92.9	1	NUC	94	90	60' N of SE End	-1.5'
3	118.1	22.8	96.2	1	NUC	97	90	120' N of SE End	-1.5'
4	114.0	19.7	95.3	1	NUC	96	90	180' N of SE End	-1.5'
5	112.7	25.1	90.1	1	NUC	91	90	240' N of SE End	-1.5'
6	118.2	26.1	93.7	1	NUC	95	90	SE End	-1.0'

(1) Test Locations Selection By: ______ Contractor x Technician
(2) Fill Placement Observed By Technician: ______ Yes x No
(3) Test Locations And Elevations Are Approximate.

Remarks: Picked up proctor sample from existing landfill cut.

*Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4

Technician: Neal Waddell Submitted to: ______

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-22-90
Time Arrived:

Project: Occidental Chemical - Landfill Closure Job # 69-90-01
Special Instructions:
Work Performed: Soil Testing at Eastern Edge

Test No.	Wet Density pcf	Moisture Content %	Dry Density pcf	*	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
16	124.1	19.6	103.7	1	NUC	100	90	210' N of SE Corner	-1'
	117.0	22.0	95.9	1	CP			Check point at Test #10	
17	116.0	11.7	103.8	2	NUC	94	90	50' W and 100'N of SE Corner	-1.5'

(1) Test Locations Selection By: ____ Contractor x Technician
(2) Fill Placement Observed By Technician: ____ Yes x No
(3) Test Locations And Elevations Are Approximate.

Remarks:

*Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4
2	D-698	111.0	15.1

Technician:
Submitted to:

UNIVERSAL TESTING, INC.

219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-22-90

Time Arrived: 8:10 am/2:00 pm

Project: Occidental Chemical - Landfill Upgrade

Job # 69-90-01

Special Instructions:

Work Performed: Testing on Soil Cup Fill (from East ditch line to 50' West)

Test No.	Wet Density pcf	Moisture Content %	Dry Density pcf	*	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
7	122.2	21.4	100.7	1	NUC	100	90	90' N of SE Corner of Landfill	-1'
8	122.5	21.9	100.5	1	NUC	100	90	210' N of SE Corner of Landfill	-1'
9	120.6	21.4	99.3	1	NUC	100	90	300' N of SE Corner	-1'
10	117.7	22.2	96.3	1	NUC	97	90	390' N of SE Corner	-1'
11	122.1	24.4	98.2	1	NUC	99	90	120' N of SE Corner	-1'
12	125.2	22.8	101.9	1	NUC	100	90	250' N of SE Corner	-1'
13	123.7	22.0	101.4	1	NUC	100	90	340' N of SE Corner	-1'
14	121.8	21.7	100.2	1	NUC	100	90	380' N of SE Corner	-1'
15	118.2	22.7	96.4	1	NUC	97	90	310' N of SE Corner	-1'

(1) Test Locations Selection By: ____ Contractor x Technician
(2) Fill Placement Observed By Technician: ____ Yes x No
(3) Test Locations And Elevations Are Approximate.

Remarks: Obtained check point sample from test location #10

*Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4

Technician: Neal Waddell

Submitted to:

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-23-90
Time Arrived: 1:00

Project: Occidental Chemical Corp. - Landfill Closure   Job # 69-90-01
Special Instructions:
Work Performed: Testing at East End of Landfill at Crown to 10' Trench

Test No.	Wet Density pci	Moisture Content %	Dry Density pcl	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
18	122.2	22.8	99.5	1	NUC	100	90	40' N of SE Corner	-6"
19	118.9	23.9	95.9	1	NUC	97	90	130' N of SE Corner	-6"
20	115.0	19.2	97.3	1	NUC	98	90	160' N of SE Corner	-6"
21	121.3	21.9	99.5	1	NUC	100	90	220' N of SE Corner	-6"
22	120.0	21.6	98.7	1	NUC	99	90	350' N of SE Corner	-6"
23	123.1	21.7	101.2	1	Sand Cone	100	90	Test Location #17	-6"

(1) Test Locations Selection By: ______ Contractor __x__ Technician
(2) Fill Placement Observed By Technician: ______ Yes __x__ No
(3) Test Locations And Elevations Are Approximate.

Remarks:

•Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4

Technician: Neal Waddell   Submitted to:

UNIVERSAL TESTING, INC.

219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-24-90

Time Arrived: 9:05

Project: Occidental Chemical - Landfill Closure   Job # 69-90-01

Special Instructions: Page 1 of 1

Work Performed: Testing Fill Placed of 3 Eastern most Grid Strips

Test No.	Wet Density pci	Moisture Content %	Dry Density pcl	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
24	123.2	23.6	99.7	1	NUC	100	90	See attached map	S.G.
25	121.4	26.3	96.1	1	NUC	97	90	See attached map	S.G.
26	117.1	22.5	95.6	1	NUC	96	90	See attached map	S.G.
27	117.7	22.1	96.4	1	NUC	97	90	See attached map	S.G.
28	117.6	22.5	96.0	a	NUC	97	90	See attached map	S.G.
29	110.8	20.2	92.2	1	NUC	93	90	See attached map	S.G.
30	123.0	23.3	99.8	1	NUC	100	90	See attached map	S.G.
31	121.3	21.8	99.6	1	NUC	100	90	See attached map	S.G.
32	120.1	22.0	98.4	1	NUC	99	90	See attached map	S.G.

(1) Test Locations Selection By: ______ Contractor __x__ Technician
(2) Fill Placement Observed By Technician: ______ Yes __x__ No
(3) Test Locations And Elevations Are Approximate.

Remarks:

•Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4

Technician: Neal Waddell   Submitted to: ______

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-24-90
Time Arrived: 9:05

Project: Occidental Chemical Corp. - Landfill Closure Job # 69-90-01
Special Instructions: Page 2 of 2
Work Performed: Testing Fill Placed at 3 Eastern Most Grid Strips

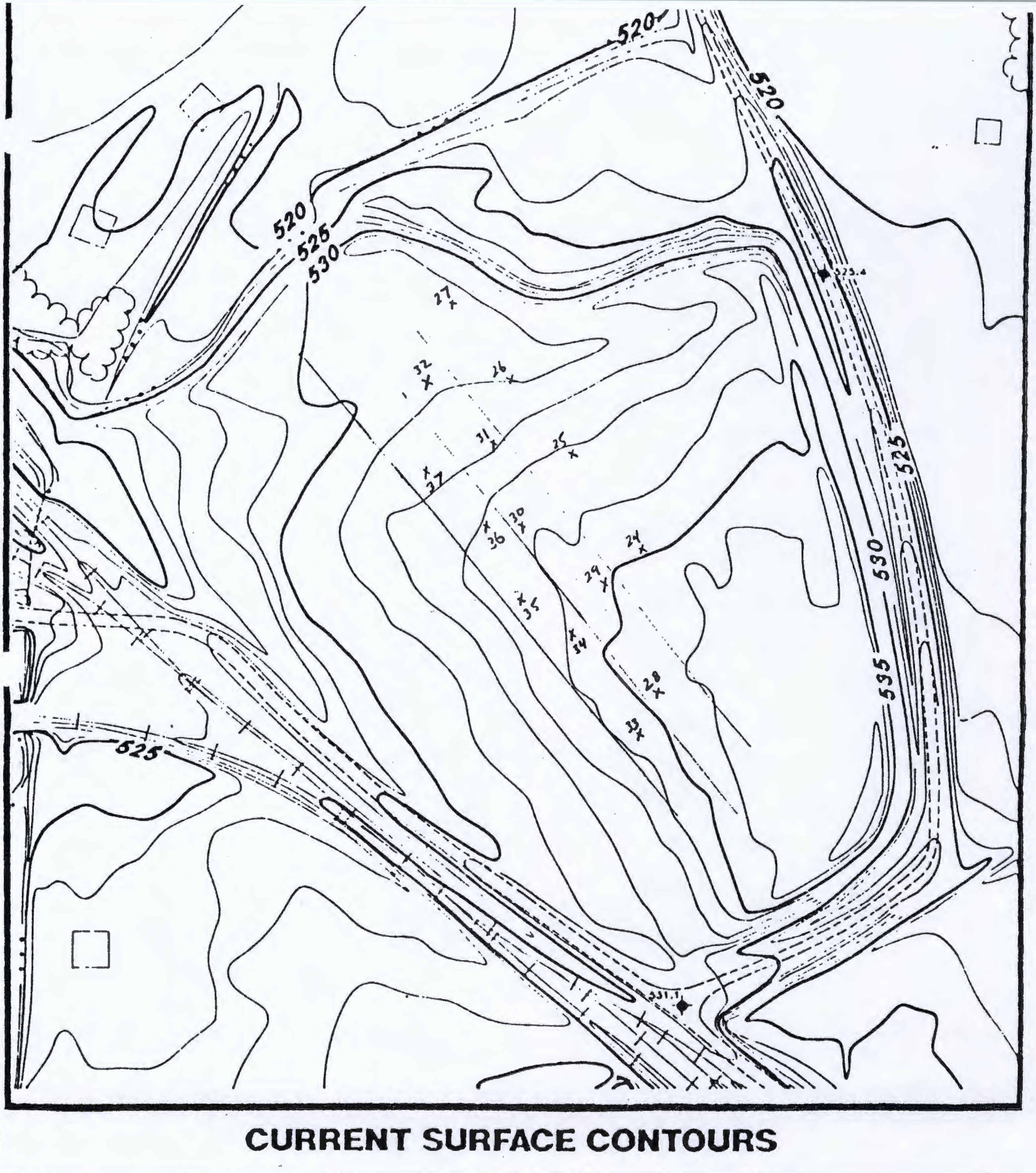
Test No.	Wet Density pci	Moisture Content %	Dry Density pcl	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
33	119.2	23.6	96.4	1	NUC	97	90	See Attached Map	S.G.
34	116.7	22.6	95.2	1	NUC	96	90	See Attached Map	S.G.
35	119.0	22.6	97.1	1	NUC	98	90	See Attached Map	S.G.
36	118.9	22.5	97.1	1	NUC	98	90	See Attached Map	S.G.
37	115.7	22.9	94.1	1	NUC	95	90	See Attached Map	S.G.

(1) Test Locations Selection By: _____ Contractor _X_ Technician
(2) Fill Placement Observed By Technician: _____ Yes _X_ No
(3) Test Locations And Elevations Are Approximate.

Remarks:

*Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4

Technician: Neal Waddell Submitted to: _____



CURRENT SURFACE CONTOURS

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-27-90
Time Arrived: 11:30

Project: Occidental Chemical - Landfill Closure
Job # 69-90-01
Special Instructions:
Work Performed:

Test No.	Wet Density pci	Moisture Content %	Dry Density pci	*	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
38	123.0	16.1	105.9	2	NUC	95	90	SEE ATTACHED MAP	S.G.
39	123.9	17.3	105.6	2	NUC	95	90		S.G.
40	122.6	20.2	102.0	1	NUC	100	90		S.G.
41	120.5	22.8	98.2	1	NUC	99	90		S.G.
42	120.4	15.8	104.2	2	NUC	94	90		S.G.
43	118.4	22.1	97.0	1	NUC	98	90		S.G.
44	120.0	24.3	96.5	1	NUC	97	90		S.G.
45	125.7	16.4	108.0	2	NUC	97	90		S.G.

(1) Test Locations Selection By: ____ Contractor x Technician
(2) Fill Placement Observed By Technician: ____ Yes x No
(3) Test Locations And Elevations Are Approximate.

Remarks:

*Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4
2	D-698	111.0	15.1

Technician: Neal Waddell
Submitted to:

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-28-90

Time Arrived: 3:45

Project: Occidental Chemical - Landfill Closure   Job # 69-90-01

Special Instructions:

Work Performed:

Test No.	Wet Density pcf	Moisture Content %	Dry Density pcf	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
46	118.6	18.9	99.7	1	NUC	100	90	SEE ATTACHED MAP	S.G.
47	122.0	23.7	98.7	1	NUC	99	90		S.G.
48	113.0	20.2	94.0	1	NUC	95	90		S.G.
49	119.2	18.5	100.6	1	NUC	100	90		S.G.
50	123.2	22.1	100.9	1	NUC	100	90		S.G.
51	120.1	22.4	98.2	1	NUC	99	90		S.G.
52	121.7	20.0	101.4	1	NUC	100	90		S.G.
53	118.3	21.0	97.7	1	NUC	98	90		S.G.
54	120.7	19.9	100.6	1	NUC	100	90		S.G.

(1) Test Locations Selection By: ____ Contractor x Technician
(2) Fill Placement Observed By Technician: ____ Yes x No
(3) Test Locations And Elevations Are Approximate.

Remarks: Moisture contents below 20% were at locations placed yesterday and this morning. These areas will be re-conditioned before placing geo-membrane.

*Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4

Technician: Neal Waddell   Submitted to: J. Zeigler

CURRENT SURFACE CONTOURS

8/27+28/1990

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-28-90
Time Arrived:

Project: Occidental Chemical Corp. - Landfill Closure   Job # 69-90-01

Special Instructions:

Work Performed: Laboratory Check Points

Test No.	Wet Density pcf	Moisture Content %	Dry Density pcf	*	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
	123.9	14.8	108.0	2	Check Point			Test Location #42	
	120.3	22.5	98.2	1				Test Location #49	

(1) Test Locations Selection By: _____ Contractor _____ Technician
(2) Fill Placement Observed By Technician: _____ Yes _____ No
(3) Test Locations And Elevations Are Approximate.

Remarks:

*Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4
2	D-698	111.0	15.1

Technician: Neal Waddell   Submitted to:

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-29-90
Time Arrived: 8:00 am

Project: Occidental Chemcial Corp. - Landfill Closure Job # 69-90-01
Special Instructions:
Work Performed:

Test No.	Wet Density pci	Moisture Content %	Dry Density pcl	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
		20.6						Stove Cooked Moisture on Borrow Material	
55	120.9	23.5	97.9	1	Check Point			Borrow Material	
56	120.3	19.3	100.8	1	NUC	100	90	Moisture Checks on Western Most 250'	S.G.
57	118.2	19.2	99.2	1	NUC	100	90	Moisture Checks on Western Most 250'	S.G.
58	120.8	20.1	100.5	1	NUC	100	90	" "	S.G.
59	118.8	22.6	96.9	1	NUC	98	90	Moisture Checks on Western Most 250'	S.G.
60	120.6	20.5	100.1	1	NUC	100	90	Moisture Checks on Western Most 250'	S.G.
61	116.0	21.3	95.6	1	NUC	96	90	Moisture Checks on Western Most 250'	S.G.
62	120.3	19.6	100.6	1	NUC	100	90	Moisture Checks on Western Most 250'	S.G.

(1) Test Locations Selection By: ____ Contractor x Technician
(2) Fill Placement Observed By Technician: ____ Yes x No
(3) Test Locations And Elevations Are Approximate.

Remarks:

•Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4

Technician: Neal Waddell Submitted to:

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-29-90
Time Arrived: 3:00

Project: Occidental Chemical Corp. - Landfill
Job # 69-90-01
Special Instructions:
Work Performed:

Test No.	Wet Density pci	Moisture Content %	Dry Density pcl	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
63	123.2	22.2	100.9	1	NUC	100	90	Western Most 250'	S.G.
64	122.0	22.5	99.6	1	NUC	100	90	Western Most 250'	S.G.
65	121.6	20.8	100.7	1	NUC	100	90	Western Most 250'	S.G.
66	120.4	21.6	99.0	1	NUC	100	90	Western Most 250'	S.G.
67	121.2	20.4	100.7	1	NUC	100	90	Western Most 250'	S.G.
68	120.5	20.4	100.1	1	NUC	100	90	Western Most 250'	S.G.
69	116.1	23.1	94.3	1	NUC	95	90	Western Most 250'	S.G.
70	120.4	20.6	99.8	1	NUC	100	90	Western Most 250'	S.G.
71	120.5	21.6	99.1	1	NUC	100	90	Western Most 250'	S.G.

(1) Test Locations Selection By: ____ Contractor x Technician
(2) Fill Placement Observed By Technician: ____ Yes x No
(3) Test Locations And Elevations Are Approximate.

Remarks: These are retests in area of Tests #44 - #54.

•Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4

Technician: Neal Waddell
Submitted to:

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-29-90

Time Arrived: 3:00

Project: Occidental Chemical Corp. - Landfill

Job # 69-90-01

Special Instructions:

Work Performed:

Test No.	Wet Density pci	Moisture Content %	Dry Density pcl	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
72	117.6	22.6	95.9	1	NUC	97	90	Western Most 250'	S.G.

(1) Test Locations Selection By: ____ Contractor _x_ Technician
(2) Fill Placement Observed By Technician: ____ Yes _x_ No
(3) Test Locations And Elevations Are Approximate.

Remarks: These are retests in area of Tests #44 - #54

•Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4

Technician: Neal Waddell

Submitted to:

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-30-90
Time Arrived: 12:00

Project: Occidental Chemical - Landfill   Job # 69-90-01
Special Instructions:
Work Performed: Middle 1/3 of Landfill (North to South)

Test No.	Wet Density pci	Moisture Content %	Dry Density pcl	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
73	126.4	17.1	108.0	2	NUC	97	90		S.G.
74	123.5	20.8	102.0	1	NUC	100+	90		S.G.
75	120.9	21.1	99.9	1	NUC	100	90		S.G.
76	121.3	16.2	104.4	2	NUC	94	90		S.G.
77	120.4	20.3	100	1	NUC	100	90		S.G.
78	124.1	16.7	106.4	2	NUC	96	90		S.G.
79	123.6	21.0	102.3	1	NUC	100	90		S.G.
80	120.7	19.3	101.2	1	NUC	100	90		S.G.
81	124.3	22.6	101.3	1	NUC	100	90		S.G.

(1) Test Locations Selection By: ____ Contractor x Technician
(2) Fill Placement Observed By Technician: ____ Yes x No
(3) Test Locations And Elevations Are Approximate.

Remarks:

•Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4
2	D-698	111.0	15.1

Technician: Neal Waddell   Submitted to:

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-30-90

Time Arrived: 12:00

Project: Occidental Chemical Corp. - Landfill

Job #69-90-01

Special Instructions:

Work Performed: Middle 1/3 of Landfill (North to South)

Test No.	Wet Density pcf	Moisture Content %	Dry Density pcf	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
82	120.6	20.8	99.9	1	NUC	100	90		S.G.

(1) Test Locations Selection By: _____ Contractor _x_ Technician
(2) Fill Placement Observed By Technician: _____ Yes _x_ No
(3) Test Locations And Elevations Are Approximate.

Remarks:

•Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4
2	D-698	111.0	15.1

Technician: Neal Waddell

Submitted to:

UNIVERSAL TESTING, INC.
219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-31-90

Time Arrived: 8:30 am

Project: Occidental Chemical Corp. - Landfill Closure   Job # 69-90-01

Special Instructions:

Work Performed: Eastern 1/3 of Landfill

	Test No.	Wet Density pci	Moisture Content %	Dry Density pci	•	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
	83	123.5	21.1	101.9	1	NUC	100	90		S.G.
	84	120.5	20.0	100.4	1	NUC	100	90		S.G.
	85	115.7	20.7	95.9	1	NUC	97	90		S.G.
	86	120.1	21.4	99	1	NUC	100	90		S.G.
	87	131.1	19.7	109.5	2	NUC	99	90		S.G.
	88	125.4	22.1	102.7	1	NUC	100	90		S.G.
	89	119.5	15.8	103.2	2	NUC	93	90		S.G.
*	90	123.4	17.9	104.7	1	NUC	100	90		S.G.
*	91	116.7	19.7	97.5	1	NUC	98	90		S.G.

(1) Test Locations Selection By: ____ Contractor x Technician
(2) Fill Placement Observed By Technician: ____ Yes x No
(3) Test Locations And Elevations Are Approximate.

Remarks: *Water was added to test areas 90 and 91 after these tests were performed.

•Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4
2	D-698	111.0	15.1

Technician: Neal Waddell

Submitted to:

UNIVERSAL TESTING, INC.

219 W. Alabama St.
Florence, Alabama 35630
205-766-4622

FIELD DENSITY REPORT

Date: 8-31-90

Time Arrived: ____________

Project: Occidental Chemical Corp. - Landfill Closure   Job # 69-90-01

Special Instructions: ____________

Work Performed: Eastern 1/3 of Landfill

Test No.	Wet Density pcf	Moisture Content %	Dry Density pcf	*	Test Method	% Comp.	% Reqd.	Location Description	Depth / Elev.
92	117.0	20.7	96.9	1	NUC	98	90		S.G.
93	111.3	24.9	89.1	1	NUC	90	90		S.G.
94	121.3	21.7	99.7	1	NUC	100	90		S.G.
95	121.3	21.7	99.7	1	NUC	99	90		S.G.
96	119.1	22.9	96.9	1	NUC	98	90		S.G.
97	117.8	21.9	96.6	1	NUC	97	90		S.G.

(1) Test Locations Selection By: _____ Contractor __x__ Technician
(2) Fill Placement Observed By Technician: _____ Yes __x__ No
(3) Test Locations And Elevations Are Approximate.

Remarks: ____________

*Proctor No.	ASTM Spec.	Maximum Dry Density pcf	Optimum Moisture Content %
1	D-698	99.0	23.4

Technician: Neal Waddell   Submitted to: ____________

EXHIBIT 8-2

LANDFILL UPGRADE DRAWINGS

EXHIBIT 10-1

WCC SAMPLING REPORT

FORMER NORTH IMPOUNDING BASIN (SWMU 3)

State of Alabama

DEPARTMENT OF PUBLIC HEALTH

State Office Building
Montgomery, Alabama 36130

IRA L. MYERS, M.D.
STATE HEALTH OFFICER

September 23, 1981

Mr. Mel Skaggs, Jr.
Environmental Services
Diamond Shamrock Corporation
1149 Ellsworth Drive
Pasadena, Texas 77501

Re: Muscle Shoals Plant
Eckhardt Site No: AL000000710

Dear Mr. Skaggs:

This office has reviewed the information you submitted by cover letter dated August 28, 1981, regarding sampling performed at the inactive North Impounding Basin on your Muscle Shoals Plant property. Based upon the information you have supplied to this office, it is our opinion that the hazardous constituents in the lagoon are in such small quantities that they pose no harm to the environment. This information will be submitted to EPA as part of our input under the Eckhardt report.

Should you have questions or comments, please feel free to contact this office.

Sincerely,

B. E. Cox

Bernard E. Cox, Jr., Chief
Industrial and Hazardous Waste Section
Division of Solid and Hazardous Waste
Environmental Health Administration

BEC:rc

cc: Joel Veater
USEPA-Region IV

Standard of 0.002 mg/l. We believe that these results show any sediments present in the North Impounding Basin to be non-hazardous. If possible, we would appreciate having your concurrence on this conclusion, or your recommendations on additional testing needed to obtain it.

We have split samples available to you on any of the samples reported to date. If you wish to receive any of these, please let me know before October 15. It is our intent to purge these samples at that time if we have no further need of them.

If you have any questions on this information, please feel free to call me at (713) 476-1247.

Sincerely,

Mel Skaggs

Mel Skaggs
IC&P Environmental Services

MMS/me
Attachment

SOUTHWEST RESEARCH INSTITUTE

POST OFFICE DRAWER 28510 · 6220 CULEBRA ROAD · SAN ANTONIO, TEXAS 78284 · (512) 684-5111

DIVISION OF CHEMISTRY
AND CHEMICAL ENGINEERING

Diamond Shamrock Corporation
Gulf Coast Area
1149 Ellsworth Drive
Pasadena, Texas 77501

August 26, 1981

Attention: Mr. Al Swift
Environmental Services

Subject: Final Laboratory Report on EP Toxicity Test (Metals only) on Soil Samples from Muscelshoals Plant (Date of Sample Receipt - August 3, 1981)

SwRI Project 01-6256-095
Diamond Shamrock P. O. AA101718-092

Dear Sir:

Attached please find the laboratory results for the soil samples from Diamond Shamrock's Muscleshoal Plant received in our laboratory on the date referenced above. The results are for the EP Toxicity Test, eight specified metals. Analysis of pesticides and herbicides were not performed as per your request.

Extraction procedures were in accordance with those specified in the Federal Register, Monday, May 19, 1980, Environmental Protection Agency, Hazardous Waste Management System, Part III, Identification and Listing of Hazardous Waste, page 33127. Analysis of the leachate metals was performed by Atomic Absorption Spectrophotometry (AAS) using either furnace or flame techniques with the exception of mercury which was analyzed by the Cold Vapor technique.

Results of all metals analyzed for all the samples submitted indicate that values are well within EPA maximum allowable concentrations. In fact the results are even lower than 0.1 of the maximum allowable levels for all metals.

Thank you for the opportunity to be of continuing service to your company.

Very truly yours,

Oscar Saenz, Jr.
Manager, Organic Analysis and
Environmental Monitoring

APPROVED:

Donald E. Johnson

Donald E. Johnson, Ph.D.
Director, Department of
Environmental Sciences

DIAMOND SHAMROCK CORPORATION
Summary of Laboratory Results
for EP Toxicity Test (Metals)

Muscleshoals Plant

Date of Sample receipt: August 3, 1981 SwRI Project No. 01-6256-095

Sample ID as Rec'd		Arsenic mg/l	Barium mg/l	Cadmium mg/l	Chromium mg/l	Lead mg/l	Mercury mg/l	Selenium mg/l	Silver mg/l
1-1-S	0-1	0.05	<0.3	<0.07	<0.06	<0.4	0.0014	<0.003	<0.05
1-1-S	1 -2	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
1-3-S	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
1-3-S	1'-1.5'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
1-6-L	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
1-6-L	1 -2'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
2-4-L	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
2-4-L	1-2'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
2-5-S	0-1	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
2-5	1-2	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
2-6-S	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	0.0012	<0.003	<0.05
2-6-S	1 -2'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
3-2-S	0-12"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
3-2-S	12"-21"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
4-3-L	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
4-3-L	1-2'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
4-3-L	2'-2.5'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
4-4-L	0-1'	<0.01	1.0	<0.07	<0.06	<0.4	0.0057	<0.003	<0.05
4-4-L	1 -2'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
4-4-L	2 -3'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
5-4-L	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
5-4-L	1 -2'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
Detection Limit		0.01	0.3	0.07	0.06	0.4	0.0007	0.003	0.05
EPA max. allowable		5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0

DIAMOND SHAMROCK CORPORATION
Summary of Laboratory Results
for EP Toxicity Test (Metals)

Muscleshoals Plant

Date of Sample receipt: August 3, 1981

SwRI Project No. 01-6256-095

Sample ID as Rec'd		Arsenic mg/l	Barium mg/l	Cadmium mg/l	Chromium mg/l	Lead mg/l	Mercury mg/l	Selenium mg/l	Silver mg/l
5-5-S	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
5-5-S	1 -2'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
7-4-S	0"-12"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
7-4-S	12"-21"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
7-4-L	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
7-4-L	1 -1.5'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
7-5-L	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	0.0038	<0.003	<0.05
7-5-L	1 -2'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
7-5-l	2 -2.5'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
8-1	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
8-1-L	1 -1.5'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
8-4-L	0-1"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
8-4-L	1'-2.1"-1"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
9-4-L	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
9-4-L	1 -2.5'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
10-1-L	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
10-1-L	1 -2'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
10-1-L	2 -2.5'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
11-3-L	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
12-2-S	0-6"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
13-1-S	0-15"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
13-[illegible] '	0-13' 5"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
Detection Limit		0.01	0.3	0.07	0.06	0.4	0.0007	0.003	0.05
EPA max. allowable		5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0

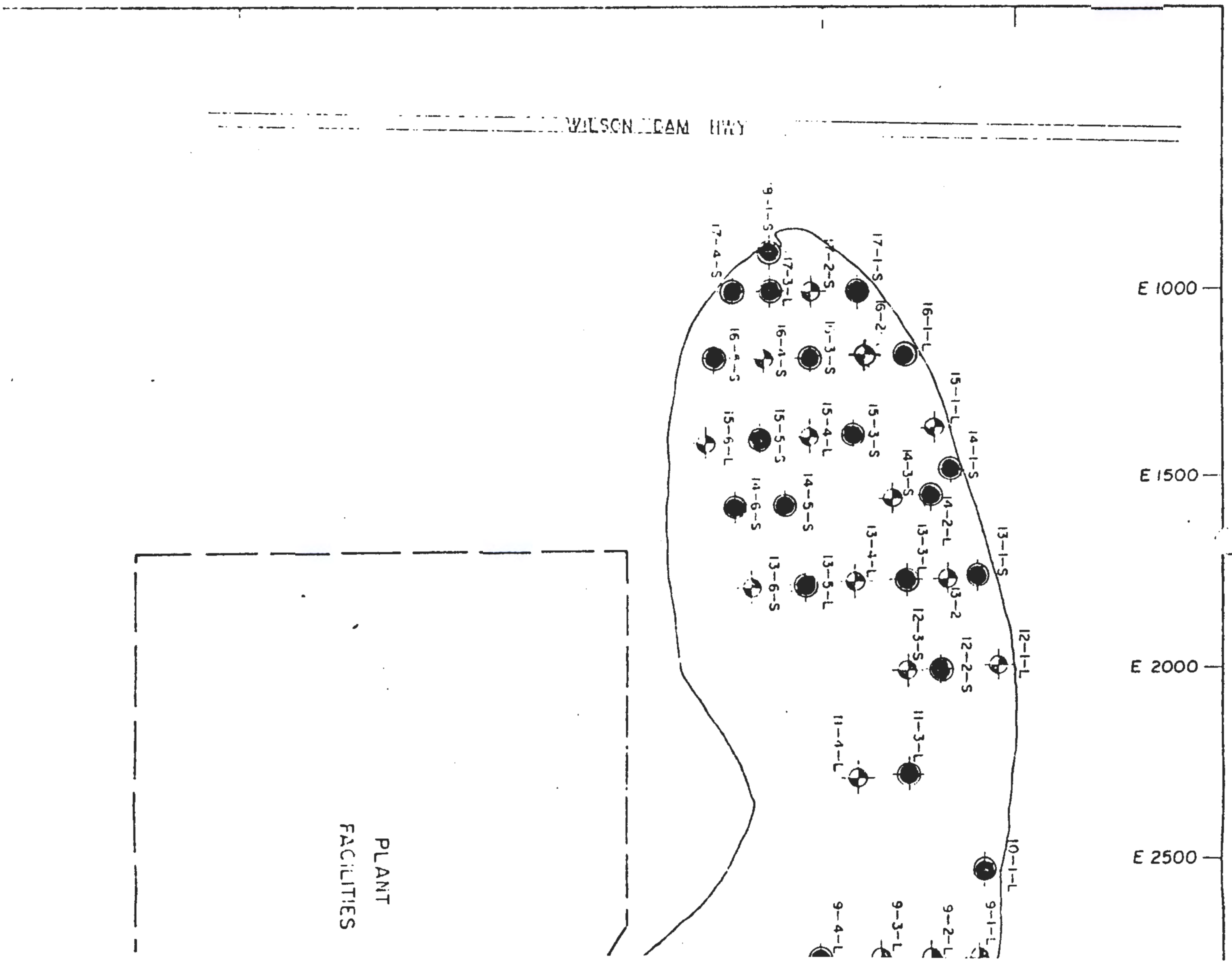
DIAMOND SHAMROCK CORPORATION
Summary of Laboratory Results
for EP Toxicity Test (Metals)

Muscleshoals Plant

Date of Sample receipt: August 3, 1981

SwRI Project No. 01-6256-095

Sample ID as Rec'd		Arsenic mg/l	Barium mg/l	Cadmium mg/l	Chromium mg/l	Lead mg/l	Mercury mg/l	Selenium mg/l	Silver mg/l
13-5-L	0-14"	<0.01	<0.3	<0.07	<0.06	<0.4	0.0023	<0.003	<0.05
14-1-S	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
14-2-L	0-14"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
14-5-S	0-1	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
14-6-S	0-12"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
15-3-S	0-0.5'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
15-5-S	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
16-1-L	0-15"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
16-3-S	0-13"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
16-[illegible] S	0-1.2'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
17-1-S	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
17-3-L	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	0.0015	<0.003	<0.05
17-3-L	1'-1.5'	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
17-4-S	0-1'	<0.01	<0.3	<0.07	<0.06	<0.4	0.0012	<0.003	<0.05
18-1-S	0-13"	<0.01	<0.3	<0.07	<0.06	<0.4	<0.0007	<0.003	<0.05
Detection Limit		0.01	0.3	0.07	0.06	0.4	0.0007	0.003	0.05
EPA max. allowable		5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0


WILSON DAM HWY
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17-4-S
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11-3-L
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9-4-L
9-3-L
9-2-L

Rod Shell - Muscle Shoals
Troy Townsend - Muscle Shoals
[redacted]
File: MS/S.W. (BHC, TS)

Diamond Shamrock

April 21, 1981

Mr. David Roberson
Division of Solid & Hazardous Waste
Alabama Department of Public Health
434 Monroe Street
Montgomery, Alabama 36130

RE: Muscle Shoals Plant
North Impounding Basin Investigation

Dear Mr. Roberson:

Attached are the results of sediment sampling and testing conducted at our Muscle Shoals Plant. These samples were collected by Woodward-Clyde Consultants, with testing conducted by Southwest Research Institute in San Antonio, Texas. These samples were analyzed in conformance with the EPA's Toxicant Extraction Procedure, as promulgated on May 19, 1980. Because no pesticides are handled at our plant, only the eight metals listed by the EPA were tested. These are results which you have previously verbally requested.

The locations of these samples were selected by our consultant blind to us, in a manner intended to maximize the probabilities of finding any contamination present. My understanding is that these locations were selected primarily based on sediment thickness and old flow patterns. These results showed the majority of these samples to contain no leachable metals, with only a very few containing any detectible levels at all. None of the 48 samples tested exceeded the EPA and ADPH hazardous waste TEP limits (or even 10% of these levels). We feel that these results conclusively show the sediments in the inactive North Impounding Basin to be non-hazardous.

If you have any questions on this matter, please call me at (713) 476-1247.

Sincerely,

Mel Skaggs

Mel Skaggs
Environmental Services

MS/bh
Attachment

Sample Location	Date Reported*	As mg/l	Ba mg/l	Cd mg/l	Cr mg/l	Pb mg/l	Hg mg/l	Se mg/l	Ag mg/l
1-2-L, 0'-1'	9/23/80	<.013	< .10	<.013	<.03	<.13	.0004	<.006	<.03
1-2-L, 1'-2'	9/23/80	<.013	< .10	<.013	<.03	<.13	<.0002	<.006	<.03
1-2-L, 2'-3'	9/23/80	<.013	< .10	<.013	<.03	<.13	<.0002	<.006	<.03
2-3-L, 0'-1'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
2-3-L, 1'-2'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
3-1-L, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	T<.002	<.002	<.07
3-1-L, 1'-2'	1/21/81	<.3	<1.0	<.03	<.13	<.5	T<.002	<.002	<.07
3-3-L, 0'-1'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
3-3-L, 1'-2'	1/21/81	<.3	T<1.0	<.03	<.13	<.5	<.002	<.002	<.07
3-4-L, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	T<.002	<.002	<.07
3-4-L, 1'-2'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
3-4-L, 2'-3'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
3-4-L, 3'-4'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
4-2-S, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
4-2-S, 1'-2'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
4-5-L, 0'-1'	9/23/80	<.013	0.30	<.013	<.03	<.13	<.0002	<.006	0.09
4-5-L, 1'-2'	9/23/80	<.013	0.13	<.013	<.03	<.13	<.0002	<.006	<.03
4-5-L, 2'-3'	9/23/80	<.013	0.45	<.013	<.03	<.13	<.0002	<.006	<.03
7-6-L, 0'-1'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
7-6-L, 1'-2'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
8-4-L, 0'-1'	9/23/80	<.013	3.3	<.013	<.03	<.13	<.0002	<.006	<.03
8-4-L, 1'-2'	9/23/80	<.013	< .10	<.013	<.03	<.13	<.0002	<.006	<.03
9-1-L, 0'-1'	1/21/81	<.3	<1.0	<.03	<.13	<.5	T<.002	<.002	<.07
9-1-L, 1'-2'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
9-2-L, 0'-1'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
9-2-L, 1'-2'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
9-2-L, 2'-3'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
9-3-L, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
9-3-L, 1'-2'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
ADPH. & EPA Limits		5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0

* Test according to procedures specified by EPA in the FEDERAL REGISTER, Volume 45, No. 98, March 19, 1980, P. 33127.

Sample Location	Date Reported*	As mg/l	Ba mg/l	Cd mg/l	Cr mg/l	Pb mg/l	Hg mg/l	Se mg/l	Ag mg/l
11-4-L, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
11-4-L, 1'-2'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
12-1-L, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.5	<.5	T<.002	<.002	<.07
12-1-L, 1'-2'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
12-3-S, 0'-1'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
13-2-L, 0'-1'	9/23/80	<.013	<0.1	<.013	<.03	<.13	<.0002	<.006	<.03
13-2-L, 1'-2'	9/23/80	<.013	<.1	<.013	<.03	<.13	<.0002	<.006	<.03
13-4-S, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
13-6-S, 0'-1'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
14-3-S, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
15-1-L, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
15-1-L, 1'-2'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
15-4-L, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
15-4-L, 1'-2'	1/21/81	<.3	<1.0	<.002	<.13	<.5	<.002	<.002	<.07
15-6-L, 0'-1'	1/21/81	<.3	<1.0	T<.002	<.13	<.5	<.002	<.002	<.07
16-2-L, 0'-1'	1/21/81	<.3	<1.0	T<.03	<.13	<.5	<.002	<.002	<.07
16-4-L, 0'-1'	9/23/80	<.013	.14	<.013	<.03	<.13	<.0002	<.006	<.03
16-4-L, 1'-2'	9/23/80	<.013	.11	<.013	<.03	<.13	<.0002	<.006	<.03
17-2-S, 0'-1'	1/21/81	<.3	<1.0	<.03	<.13	<.5	<.002	<.002	<.07
ADPH & EPA Limits		5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0

* Test according to procedures specified by EPA in the FEDERAL REGISTER, Volume 45, No. 98, March 19, 1980, P. 33127.

EXHIBIT 16-1

SUMMARY OF DISCHARGE MONITORING REPORT DATA

EXHIBIT 16-1

SUMMARY OF DISCHARGE MONITORING REPORT DATA

SWMU 13, SCRUBBER SOLUTION TREATMENT TANKS

CHLORINE SCRUBBER ANALYSIS 1991 & 1992

	FLOW gal/day	TRC mgs/l	TRC lbs/day	TSS g/l	TSS lb/day	Mercury ppb	Mercury lbs/day	Nickel ppm	Nickel lbs/day
15-Jan-91	21,788	0.50	0.09	0.015	2.6	0.30	<0.001	0.00	0.00
05-Mar-91	22,275	<0.02	0.00	0.044	8.2	1.40	<0.001	6.30	1.20
13-May-91	34,616	0.02	0.01	0.003	0.8	0.40	<0.001	0.00	0.00
29-May-91	26,991	<0.02	<0.01	0.011	2.4	0.80	<0.001		
01-Oct-91	30,622	<0.02	<0.01	0.036	9.1	0.10	<0.001		
26-Dec-91	24,270	<0.02	<0.01	0.028	5.8	3.00	<0.001		
18-Feb-92	16,631	<0.02	<0.01	0.010	1.4	1.0	<0.001		
27-Feb-92	24,571	<0.02	<0.01	0.043	8.8	1.0	<0.001		
01-Mar-92	40,307	<0.02	<0.01	0.033	11.2	<0.2	<0.001		
04-Mar-92	25,420	<0.02	<0.01	0.124	26.3	0.2	<0.001		
11-Mar-92	26,997	<0.02	<0.01	0.009	2.0	<0.2	<0.001		
04-May-92	18,119	<0.02	<0.01	0.024	3.6	<0.2	<0.001		
27-May-92	28,563	<0.02	<0.01	0.027	6.3	<0.2	<0.001		

Note: This unit is regulated in conjunction with the facility NPDES Permit.

APPENDIX A

FIELD INVESTIGATION PROTOCOLS

APPENDIX A

FIELD INVESTIGATION PROTOCOLS

This appendix contains protocols for site investigation techniques which will be utilized during the proposed RCRA Facility Investigation (RFI).

- A-1 Soil Exploration Borings;
- A-2 Surface Soil, Sediment, and Grab Sampling;
- A-3 Groundwater Sampling; and
- A-4 Site Health and Safety Plan.

APPENDIX A
FIELD INVESTIGATION PROTOCOLS

A-1 Soil Exploration Borings. Soil exploration borings will be advanced using vehicular-mounted equipment in accordance with the following procedures:

- o Borings will be advanced using a dry auger procedure until groundwater is encountered. The water level will be allowed to stabilize and then the fluid level will be measured using an electronic water level measurement probe. After the fluid level is recorded, drilling operations will continue using either a hollow-stem auger (with no drilling fluids), wash boring, air rotary, or mud rotary method.

- o Soil samples will be taken on five-foot centers, or change of strata down to the limestone bedrock. The soil samples will be collected using hydraulically-advanced split-spoons, shelby tubes or a continuous sampler.

- o Soil samples for chemical analysis will be collected and documented for analyses. Excessively disturbed or loose material, not representative of the interval sampled, will be discarded with other boring soils at each boring location. The soil sample will be placed on a clean sheet of aluminum foil using clean surgical gloves. Soil samples will be trimmed of any portions that may have become contaminated by external conditions. The samples will then be placed in sample containers (glass jars) provided by a selected analytical laboratory and stored in an iced-down cooler.

- o All sampling equipment will be thoroughly cleaned between each use. The drill rig and related equipment will be pressure cleaned after each boring.

- o Equipment rinse blanks will be collected daily and analyzed to verify that the decontamination processes are adequate.

- o Discarded soil materials will be stored and sealed in a drum container for proper disposal.

- o After completion of soil sampling, the borehole will be sealed from bottom to the surface with cement-bentonite grout.

Analytical Methods. Most soil samples will be analyzed for total and TCLP mercury, total and TCLP cadmium, and total chloride. Selected soil samples will be analyzed for TCLP herbicides or TCLP polychlorinated biphenyls. The analytical methods are presented in Table A-1.

Laboratory Analytical Methods, Containers, Preservative, and Holding Times.

Total Mercury: Method 7471; Container: 8 ounce, glass container; holding time: 28 days; No preservative

TCLP Mercury: Method 1311/7471; Container: 1 liter, glass bottle; holding time: 56 days (28 days before extraction and 28 days before determinative analysis); no preservative

Total Cadmium: Method 7131; Container: 8 ounce, glass container; holding time: 180 days; No preservative

TCLP Cadmium: Method 1311/7131; Container: 1 liter, glass bottle; Holding time: 360 days (180 days before extraction and 180 days before determinative analysis; No preservative

Total Chloride: Method 9252; Container: 1 liter, glass bottle; Holding time: 28 days; No preservative.

Polychlorinated Biphenyls (PCBs): Method 8080; Container: 4 ounce glass container; Holding time: 14 days until extraction and 40 days after; Preservative: cooling to 4°C

TCLP PCBs: Method 1311/8080; Container: 1 liter, glass bottle; Holding time: 61 days (14 days before extraction, 7 days before preparative extraction, and 40 days before determinative analysis; Preservative: cooling to 4°C.

TCLP Herbidices: Method 1311/8150; Container: 1 liter, glass bottle; Holding time: 61 days (14 days before extraction, 7 days before preparative extraction, and 40 days before determination analysis; No preservative.

Chain-of-Custody Control. The chain-of-custody form will identify all samples, the date and time of collection, the individual performing the sampling, the matrix, the total number of containers, the analyses and analytical methods to be performed, and the presence or absence of preservative. It will be completed for all samples immediately upon completion of the field work, and signed by all persons involved with collection and transportation of the samples. The chain-of-custody form will be returned by the laboratory, appropriately signed, with the sample analytical results.

Sample Documentation. Documentation will be completed for the samples as follows:

- Each sample will be labeled with the following information: job identification number, sample identification number, sample description, facility where sample was obtained, location of facility, collector of sample, date of sampling, and the time of sampling.

A-2 Surface Soil, Sediment, and Grab Sampling. Surface soil, sediment, and/or grab samples will be collected with either a stainless steel coring device (6-inch core samples), pvc bailers (push method), or hand tools. The sampling device will be selected based on the sampling situation and conditions. A brief description of the sampling apparatus is presented below:

Coring Device. The coring device is equipped with a 1-1/2 inch (diameter) by 6 inch stainless steel sampling tube and a carbon steel sliding handle. This coring device will be used to collect surface soils, subsurface soils, and sediment samples. A hand auger will be used to advance the coring device for samples 2.5 feet below the surrounding grade.

PVC Bailer. PVC bailers is an alternate sampling method for sediment samples. If sediment samples are not retained in the 6 inch tube, a PVC bailer will be used to collect the sediment sample.

Hand Tools. If the soil media prevents the use of the coring device and PVC bailer, hand tools will be used to collect the soil samples. Hand tools include stainless steel trowels, spatulas, and ladles, shovels, post-hole diggers, hand augers, and pry bars.

Soil samples for chemical analysis will be collected and documented for analyses in accordance with the following procedures:

- Soil samples will be trimmed of any portions that may have become contaminated by external conditions.

- If applicable, grab samples will be composited in a stainless steel mixing container. Careful observance of the soil will indicate the completeness of the mixing.

- Soil samples will be placed in chemically cleaned sample containers provided by selected analytical laboratory and placed in an iced-down shipping container.

- o The sample containers will be labeled for sample identification.

- o All sampling equipment will be thoroughly field cleaned between each use.

- o Equipment rinse blank will be collected daily and analyzed to verify that the decontamination processes are adequate.

- o Discarded soil materials will be stored and sealed in a drum container for properly disposal.

Analytical Methods. Typically, soil samples will be analyzed for total and TCLP mercury, total and TCLP cadmium, total chloride, and select samples will be analyzed for polychlorinated biphenyls (PCBs) or TCLP herbicide. The analytical methods are presented in Table A-1.

Laboratory Analytical Methods, Containers, Preservative, and Holding Times.

Total Mercury: Method 7471; Container: 8 ounce, glass container; Holding time: 28 days; No preservative

TCLP Mercury: Method 1311/7471; Container: 1 liter, glass bottle; Holding time: 56 days (28 days before extraction and 28 days before determinative analysis); No preservative

Total Cadmium: Method 7131; Container: 8 ounce, glass container; Holding time: 180 days; No preservative.

TCLP Cadmium: Method 1311/7131; Container: 1 liter, glass bottle; Holding time: 360 days (180 days before extraction and 180 days before determinative analysis; No preservative.

Total Chloride: Method 9252; Container: 1 liter, glass bottle; Holding time: 28 days; No preservative.

Polychlorinated Biphenyls (PCBs): Method 8080; Container: 4 ounce glass container; Holding time: 14 days until extraction and 40 days after; Preservative: cooling to 4°C

TCLP PCBs: Method 1311/8080; Container: 1 liter, glass bottle; Holding time: 61 days (14 days before extraction, 7 days before preparative extraction, and 40 days before determinative analysis; Preservative: cooling to 4°C

TCLP Herbidices: Method 1311/8150; Container: 1 liter, glass bottle; Holding time: 61 days (14 days before extraction, 7 days before preparative extraction, and 40 days before determination analysis; No preservative

Chain-of-Custody Control. The chain-of-custody form will identify all samples, the date and time of collection, the individual performing the sampling, the matrix, the total number of containers, the analyses and analytical methods to be performed, and the presence or absence of preservative. It will be completed for all samples immediately upon completion of the field work, and signed by all persons involved with collection and transportation of the samples. The chain-of-custody form will be returned by the laboratory, appropriately signed, with the sample analytical results.

Sample Documentation. Documentation will be completed for the samples as follows:

- o Each sample will be labeled with the following information: job identification number, sample identification number, sample description, facility where sample was obtained, location of facility, collector of sample, date of sampling, and the time of sampling.

A-3 Groundwater Sampling. The monitor wells will be gauged and sampled in accordance with the guidelines presented in the U.S. Environmental Protection Agency, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, September 1986. A record of the groundwater measurement and sampling event will be presented in the report. Water samples for laboratory analysis will be collected as follows:

Groundwater samples will be collected using dedicated PVC bailers. The pre-cleaned (steam cleaned) bailers will be removed from clean storage sleeves and clean (unused) nylon line will be attached. Precautions will be taken so that neither the line nor the bailer contact the ground or any other potentially contaminated surface. Each bailer will be stored within the respective well casing between sampling events.

Sampling.

- New, clean latex gloves and dedicated PVC bailers will be used to collect each sample.

- Before sampling, each well will be purged of at least three well casing volumes of water or until dry.

- Samples for analytical laboratory analysis and field testing will be collected from each well using the dedicated bailer. Since the purge water is derived from the same formation as the water to be sampled, bailers will not require field cleaning between purging and sampling.

Groundwater Sample Preservation/Shipment.

- Samples will be placed in containers provided by the analytical laboratory and each container will be individually labeled. Containers for a given sample will be placed in a plastic bag and sealed. Samples, as they are collected, will be placed in ice chests that have been previously cooled to 4°C.

- o Care will be taken when filling any containers containing preservative to prevent loss of preservative due to overfilling of the sample container.

- o Samples will be delivered to the laboratory at the completion of the work by a company vehicle or will be picked up by the laboratory carrier. For long-term field sampling events, the samples will be periodically sent from the field to the laboratory by common carrier, and proper chain-of-custody documentation will be prepared.

Field and Laboratory Analytical Procedures.

Field Measurements.

- o The pH of groundwater samples will be determined immediately upon sampling, using a calibrated pH probe.

- o Specific conductivity of groundwater samples will be determined immediately upon sampling using a calibrated conductivity probe.

- o Temperature of groundwater samples will be determined immediately upon sampling using either the pH meter or conductivity probe.

Analytical Methods. Mercury will be analyzed by Method 7470, cadmium by Method 7131, and PCBs by Method 8080, U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Washington D.C., November 1986. Chloride will be analyzed by Method 4500-Cl-C, American Public Health Association, American Water Works Association, Water Pollution Control Federation, Standard Methods for the Examination of Water and Wastewater, 17th Edition, Washington D.C., September 1989.

Laboratory Analytical Methods, Containers, Preservative, and Holding Times.

Total Mercury: Method 7470; Container: 1 liter, glass bottle; Holding time: 28 days; Preservative: Nitric Acid

Total Cadmium: Method 7131; Container: 1 liter, glass bottle; Holding time: 6 months; Preservative: Nitric Acid

Polychlorinated Biphenyls: Method 8080; Container: 1 liter, glass bottle; Holding time: 7 days until extraction and 40 days after extraction; Preservative: cooling at 4°C

Total Chloride: Method 4500-Cl- C; Container: 250 ml, clear glass bottle; Holding time: 28 days; No preservative required

Chain-of-Custody Control. The chain-of-custody form will identify all samples, the date and time of collection, the individual performing the sampling, the matrix, the total number of containers, the analyses and analytical methods to be performed, and the presence or absence of preservative. It will be completed for all samples immediately upon completion of the field work, and signed by all persons involved with collection and transportation of the samples. The chain-of-custody form will be returned by the laboratory, appropriately signed, with the sample analytical results.

Documentation of Proper Sampling and Analysis Procedures.

Sample Documentation. Documentation will be completed for the samples as follows:

- o Each sample will be labeled with the following information: job identification number, sample identification number, sample description, facility where sample was obtained, location of facility, collector of sample, date of sampling, and the time of sampling.

- o A field log will document weather conditions, description of media being collected, where the sample was taken, and procedures employed for ensuring that a homogeneous, valid sample is reproducibly obtained.

- o A monitor well sampling record will document all pertinent water level measurements and purging and sampling information during the sampling event.

Quality Assurance/Quality Control (QA/QC) Blanks.

Trip Blanks. A trip blank for each method of analysis in each sample cooler will be provided by the laboratory for analysis. The trip blanks will be maintained in the same environment as the sample containers.

Equipment Blanks. An equipment blank will be collected for the medium being sampled for 10 percent or every 20 samples collected which ever is less. At least one blank per day of sampling will be collected for analysis. Equipment blanks will be collected by filling sample containers with analyte-free water rinsed through sampling equipment just before the equipment is used to collect a sample.

Replicate Samples. One set of replicate samples will be collected for the medium being sampled for every 20 samples collected. At least one replicate per day of sampling will be collected for analysis. The replicate samples will be submitted to the laboratory for analysis under a separate identification from the original.

Procedure for Determining Groundwater Elevation. Water level measurements will be made (measured from top-of-casing) at the beginning of each sampling event and groundwater elevations will be directly determined from these measurements.

A-4 Health and Safety Plan.

A. Site Description.

Location: Occidental Chemical Corporation (OxyChem), Muscle Shoals, AL
Type of Site: Industrial Chemical Plant
Topography: Flat to low-lying hills
Additional Information: Facility "Safety Rules and Regulations for Contractors," dated 10/83, provided as Exhibit A-1.

B. Onsite Control.

OxyChem will provide access control and security onsite.

Evacuation Procedure: Evacuation routes from the work area will be explained and noted to all personnel prior to the activity.

C. Organization and Coordination.

G&E Project Manager: Juliette Pierce, (504) 292-9007
G&E Safety Coordinator: Linda Simons, (407) 269-9891
OxyChem Safety Officer: Warren Rutland, (205) 389-2215
OxyChem Environmental Engineer: Chris Manley, (205) 389-2350

D. Hazard Evaluation.

The following substances or compounds may exist or have been confirmed to exist by previous investigative efforts at the site and may pose chemical hazards.

Mercury

- Hazards: Health (Toxic)
- Routes of Exposure: Ingestion, inhalation, absorption (skin and eye contact).
- Exposure Effects: Irritation of the eyes and skin, gastrointestinal (GI) disturbances, headache, cough, chest pain, irritability, indecision, dizziness, weakness, and fatigue.
- Target Organs: Central Nervous System (CNS), respiratory system, kidneys, skin, eyes.

Cadmium

- Hazards: Health (Carcinogen)
- Routes of Exposure: Ingestion, inhalation, absorption (skin and eye contact).
- Exposure Effects: GI disturbances, headache, chills, vomiting, cough, chest tightness, and muscle aches.
- Target Organs: Respiratory system, kidneys, blood, prostate.

Chloride

- Hazards: Health (Slight)
- Routes of Exposure: Ingestion, inhalation, absorption (skin and eye contact).
- Exposure Effects: Irritation of the eyes and skin.
- Target Organs: Skin, eyes, blood.

Heat Stress: An additional physical hazard that could exist onsite is heat stress due to the hard physical work coupled with restrictive and confining safety clothing. There are several types of heat stress:

- Heat rash: Results from continuous exposure to heat or humid air.

- Heat cramps: Caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - o Muscle spasms
  - o Pain in the hands, feet, and abdomen.

- Heat exhaustion: Occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - o Pale, cool, moist skin
  - o Heavy sweating
  - o Dizziness
  - o Nausea
  - o Fainting

- Heat stroke: Most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occur. Medical help must be obtained. Signs and symptoms include:

  - o Red, hot, unusually dry skin
  - o Lack of or reduced perspiration
  - o Nausea
  - o Dizziness and confusion

- o Strong, rapid pulse
- o Coma

As a minimum, to prevent heat stress the following precautions shall be taken when Level C PPE or higher is worn and whenever the air temperature is above or equal to 70 degrees Fahrenheit (F) or if the relative humidity is above 60%:

- ♦ At each break, tepid water and/or electrolyte fluids shall be made available. Each person should drink fluids at the break consistent with his/her fluid loss recognizing that his/her level of thirst is not a good indicator of fluid loss. The water and electrolyte fluids containers shall be cleaned and refilled daily, and disposable cups shall be used to promote proper personal hygiene safety.

- ♦ Oral temperature monitoring shall be done at the beginning of each break period.
  - o If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the break period.

  - o If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next break period, shorten the following work cycle by one-third.

  - o If oral temperature ever exceeds 100.6°F (38.1°C) do not allow personnel to wear personal protective clothing.

Personnel shall pay close attention to physical hazards at the site. All safety practices and precautions typical of the industry shall be taken when working near drilling equipment. Eating, drinking, or smoking in the work zone is prohibited. Hands and face shall be thoroughly washed after work and before eating, drinking, or smoking. No alcohol shall be consumed before, during, or directly after work.

E. Personnel Protective Equipment (PPE).

Level D:

- Safety boots/shoes (steel-toed).
- Hard hat.

Options:

- Gloves (latex). [Although gloves are optional for personal protection, wearing of latex gloves for certain activities is required for Quality Assurance purposes.]
- Tyvek™ coveralls.
- Safety glasses or chemical splash goggles.
- Heating protection.

Level D PPE will be the primary level of protection. Air monitoring (Dräger tubes for mercury) performed during previous similar activities at this site has never indicated a need to upgrade to Level C.

Level C:

- Half-face respirator with appropriate cartridges (i.e. organic vapor acid gas cartridges, etc.), OR
- Full-face respirator with appropriate cartridges (i.e. organic vapor acid gas cartridges, etc.).
- Chemical-resistant clothing (e.g. Tyvek™ coveralls).
- Chemical-resistant safety boots/shoes (steel-toed).
- Inner and outer chemical-resistant gloves (2 pair).
- Hard hat.
- Safety glasses or chemical splash goggles if half-face respirator is worn.

Options:

- Heating protection.

Respirator cartridges shall be changed a minimum of once a day or whenever breakthrough is evident (chemical odor presence).

Reasons to upgrade PPE from Level D to Level C:

- Change in work task that will increase contact or potential contact with hazardous materials as determined by G&E.
- Request of the individual performing the task.

Reasons to downgrade PPE from Level C to Level D:

- New information indicating that the situation is less hazardous than was originally thought as determined by G&E.
- Change in site conditions that decrease the hazard as determined by G&E.
- Change in work task that will reduce contact with hazardous materials as determined by G&E.

A further upgrade to Level B is a remote possibility. Generally, in lieu of upgrading to Level B operations will be suspended until the above listed criteria have been met for Level C or D.

F. Decontamination.

Level D PPE:

1. Steam clean equipment and tools.
2. Remove and dispose of gloves and Tyvek™ coveralls, if applicable.

3. Wash hands and face after work and before eating, drinking, or smoking.
4. Wash any affected areas of skin immediately after contact with contaminated material.

Level C PPE:

1. Steam clean equipment and tools and rinse equipment.
2. Wash outer gloves and boots.
3. Rinse outer gloves and boots.
4. Remove outer gloves, boots, and Tyvek™ suit.
5. Dispose of outer gloves and Tyvek™ suit.
6. Remove and clean respirator.
7. Remove inner gloves.
8. Dispose of inner gloves.

Disposable equipment, once expended, shall be placed in trash bags and properly disposed of.

G. Communication Procedures.

All site personnel shall familiarize themselves with the existing plant alarms for fire, chemical spill, and plant site evacuation upon arrival at the job site.

Additional information is available in OxyChem's Safety Rules and Regulations for Contractors, dated 10/83 (Exhibit A-1).

H. Emergency Response.

Whenever there is an accident with injuries, if possible, remove the victim from the work zone and decontaminate. If the victim cannot be removed from the work zone, notify the emergency personnel that the victim may have been exposed to aromatic hydrocarbons.

All emergencies or accidents shall be reported to the G&E office specified in Attachment B.

First-Aid kits shall be readily available.

A-1
ANALYTICAL METHODS AND DETECTION LIMITS

	Soil Method[1]	Soil Detection Limit	Water Method	Water Detection Limit
Total Hg	7471	**DL = 4 µg/kg	7470[1]	*PQL = 2 µg/l
Total Cd	7131	**DL = 10 µg/kg	7131[1]	*PQL = 1 µg/l
Total Cl	9252	**DL = 2 mg/kg	4500-Cl-C[2]	**DL = 2 mg/l
PCB	---	---	8080	*PQL = 50 µg/l
TCLP Hg	1311/7470	***PQL = 2 µg/l	---	---
TCLP Cd	1311/7131	***PQL = 1 µg/l	---	---
TCLP PCB	1311/8080	****DL = 1 µg/l	---	---
TCLP Herbicides	1311/8150	****DL = 0.7-2500 µg/l	---	---

References

[1]U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846); Washington, D.C. November 1986.

[2]American Public Health Association, American Water Works Association, Water Pollution Control Federation. Standard Methods for the Examination of Water and Wastewater, 17th edition. Washington, D.C., September 1989.

Notes

*40 CFR 264, APP. IX indicates a practical quantitation limit (PQL) for this constituents.
**Varies with sample size; detection limits (DL) shown are for typical sample masses (5 to 10 grams). From discussions with Southern Petroleum Laboratories, Inc. of Lafayette, Louisiana.
***The 40 CFR 264, APP. IX PQL will be required for the analysis of the TCLP extract.
****SW-846 indicates a method detection limit and a multiplier for applicable matrix (groundwater, relatively clean soil, etc.). The detection limits in the table reflect this approach and will be required of the TCLP extract. For the herbicides, the range reflects the SW-846 detection limit calculation for the herbicides for which analyses are conducted.

EXHIBIT A-1

OCCIDENTAL CHEMICAL CORPORATION'S

SAFETY RULES AND REGULATIONS FOR CONTRACTORS

To: ______________________

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SAFETY RULES AND REGULATIONS FOR CONTRACTORS

The following safety regulations (as well as governmental regulations) are considered to be a part of each contract between Contractor and Owner and must be obeyed by contractors and their employees. In addition each contractor is required to take any and all precautions deemed necessary by Owner.

NOTICE TO CONTRACTOR'S EMPLOYEE

You must read these rules before starting work for the first time on this project and obey them.

Signed: G&E ENGINEERING, INC.

By: ______________________
On Site Representative

OWNER'S RULES FOR CONTRACTOR'S EMPLOYEES

These rules must be read by each of Contractor's employees before he starts his work on the site and obeyed. The safety rules included here are an extension and reinforcement of Owner's own safety program and Owner's concern for the safety of Owner's employees, to include the safety of Contractor's employees, as well as others who may be on or near the site during construction. The safety of any job, even the most hazardous, can be improved by observing proper safety rules. These rules will supplement Contractor's rules and Contractor's employees own good judgement regarding safety.

1. OWNER'S FACILITIES

.1 Park only in areas designated for your use and enter only through the entrance designated for construction use. Unless special permission is granted by Owner through your foreman, you will not be permitted to use Owner's canteens, lunch rooms, cafeteria, or sanitary facilities.

.2 Wandering about the premises is forbidden. You will be permitted in your own work areas only and you must not enter any building or area unless required to do so in connection with your work.

.3 Do not interfere with Owner's operations or employees, or block access to Owner's facilities or emergency equipment.

.4 Lunch boxes, packages and vehicles are subject to inspection upon entering or leaving the site.

2. NO SMOKING AREAS

The "No Smoking" rule will be strictly enforced for everyone's safety. Do not weld or use open flames or spark-producing tools in a "No Smoking" area unless you have been issued a written permit. Obtain permit through your foreman from Owner's Site Representative.

3. SMOKING, INTOXICANTS, DRUGS, GAMBLING AND FIREARMS

Gambling and the use or presence of intoxicants, illegal drugs and firearms on the premises will not be tolerated.

4. PERSONAL SAFETY EQUIPMENT

.1 Eye Protection: All personnel must wear approved eye protection at all times while on the premises. (Provided by the contractor or his employee.)

.2 Hard Hats: Personnel wear hard hats on all construction work. (Provided by the contractor or his employee.) Bump hats or metal caps are forbidden.

.3 Clothing: All personnel working on Company property shall be fully clothed at all times. It is recommended that safety shoes and other hazard eliminating clothing be considered and its use encouraged.

5. LADDERS

.1 When ladders are to be used in a roadway or main aisle or in an area where fork trucks and other vehicles are used, the area must be roped off or a person stationed by the ladder to protect the person on the ladder.

.2 All straight and extension ladders must be equipped with approved safety feet.

.3 To prevent a ladder from slipping, a person must be stationed to hold it at the bottom or the ladder must be tied in place.

.4 Only dielectric ladders in safe condition may be used. NO ALL METAL LADDERS ARE TO BE USED.

.5 Contractors are not to use Company ladders. Contractors are required to furnish their own planks and rope.

6. SCAFFOLD

.1 Safe and adequate scaffolding must be used. Portable scaffold, when used, must be lashed or cleated in place. A suitable railing must be used on scaffolding in conformity with governmental regulations.

7. OVERHEAD WORK

.1 No overhead work is permissible when Owner's employees are underneath. Roadways must be barricaded when workers are on roofs having eaves parallel to roadway.

.2 All girders, beams and overhead surfaces shall be kept free of nuts, tools, bolts and other material.

8. ELECTRICAL

.1 Only authorized and qualified personnel shall work on the installation, wiring, trouble shooting or repair of electrical equipment.

.2 All electrical work including temporary wiring shall be done in accordance with the current National Electric code.

9. EXCAVATIONS

.1 All excvations or holes in floors, roofs or other levels on which personnel could walk must be safeguarded with adequate barriers.

.2 Before starting any excavating in any area, the contractor must contact Owner's Site Representative for information concerning concealed electric lines, pipes, etc.

.3 Extreme caution must be taken to avoid fouling or striking underground cables or other installations.

.4 All excavations shall be adequately braced and shored to comply with governmental standards.

10. CRANES

.1 Cranes and other heavy equipment must be guided into and out of the plant by a person walking in front of the vehicle at a safe distance.

.2 No person shall ride on a crane ball, cable or boom.

.3 Areas within the swing radius of the rear of the rotating superstructure of the crane shall be barricaded to prevent personnel from being struck or crushed by the crane.

.4 Crane booms must not be operated within 10 feet of live electrical wires.

11. VEHICLES

.1 Contractors are not permitted to use Owner's mobile equipment such as cranes, tractors, industrial trucks or machinery unless specifically authorized in writing to do so.

.2 Automobiles and other vehicles shall be parked only in designated areas.

.3 The maximum speed limit on Owner's property is 10 miles per hour except where otherwise posted. Lower limits prevail as determined by conditions. Safety in the operation of mobile equipment is of prime importance.

12. HOT WORK PERMITS

.1 Contractors shall contact Owner's production supervisor in charge of area to obtain a burning or welding permit before starting any flame, cutting, welding, grinding, sandblasting or other hot work (typical permit form Section 10).

.2 Contractor shall provide a fire watch if the hazard dictates the need for one.

.3 All compresseed gas cylinders must be stored in an upright position and properly secured.

.4 Contractor shall provide adequate fire extinguishers in good working order and properly filled. NO PERMIT WILL BE ISSUED UNLESS A WORKABLE EXTINGUISHER IS PRESENT.

.5 Vaporizing liquid type fire extinguishers containing carbon tetrachloride and soda water type are not permitted.

.6 Contractor may not use company fire extinguishing equipment except in an emergency.

.7 Where cutting, burning or welding is to be done overhead, a person must be stationed below with an approved fire extinguisher.

.8 Arc welding done at floor level must be shielded to protect personnel from the welding arc.

.9 Acetylene and oxygen welding torches must have approved backflow prevention check valves. Cylinders must be turned off after use.

.10 Tarpaulins used shall be fire resistant. The placement and use of tarpaulines shall be under STRICT supervision and control of Owner.

.11 Fire hydrants and hoses are not to be used without written permission, except to fight fires.

13. STORAGE OF FLAMMABLE LIQUIDS

.1 Paint, paint thinner, gasoline, oil or other flammable materials shall be stored only in reasonable quantities and in approved safety containers. The area where such materials may be stored MUST be accessible and clean at all times. NO SMOKING signs must also be placed at the storage site. CONTAINERS MUST BE PROPERLY IDENTIFIED AS TO CONTENTS.

14. COMPRESSED GAS CYLINDERS

.1 Compressed gas cylinders must be moved, stored or handled in an upright position. Transporting horizontally or by means of "barrel rolling" tactics is forbidden. NO cylinder shall be moved with the protective cap off or regulator attached except when secured in an approved welding buggy. ALL cylinders whether charged or empty must be secured in an upright and approved manner remote from possible damage.

15. CONFINED SPACES

.1 No person shall enter a confined space (tank, vessel, vault, pit, sewer or enclosed structure with restricted means of escape) until a confined space entry permit is issues and signed by Owner's supervisor in charge of the confined space work area (see typical permit form in Section 10).

16. GENERAL PRACTICES

.1 The only safe source of drinking water is a drinking fountain. Other sources should not be used (e.g. hoses).

.2 Contractor personnel must not enter any building or area not required by their work. Wandering about the plant is prohibited.

.3 Picture taking or possession of a camera on the site is prohibited unless written permission is obtained from Owner's Site Representative.

17. HOUSEKEEPING

.1 Good housekeeping practices are to be followed and the work place kept clean and orderly. Trash shall be deposited in proper waste containers.

.2 At no time shall any material or equipment be placed so as to block aisles, exits, ladders or other emergency equipment.

18. MACHINERY GUARDING

.1 Machinery, tools and equipment must not be operated without all guards and safety devices in place and functioning properly.

19. FIRE PROTECTION

.1 Fire hydrants, extinguishers, hose racks and other emergency equipment shall not be covered or blocked and fire equipment lanes must always be kept clear.

.2 All fires must be investigated and reported (see "Incident Report", Section 10) to the Owner regardless of duration or extent.

20. RAILROADS

.1 Blue flags must be placed on railroad tracks when the entrance of a train would present a hazard to personnel or equipment.

21. INJURIES

.1 Owner's Site Representative shall be notified immediately in the event of death, occupational disease, or a recordable injury to a contractor employee, whether or not it is determined that "lost time" will be involved. All injuries must be investigated using the Accident Report Form, Section 10.

.2 Contractor shall see that all injured personnel receive proper first aid attention immediately. Provisions for medical care shall be agreed to by Owner prior to commencement of the project.

22. TEMPORARY BUILDINGS

.1 Temporary buildings and materials storage areas shall only be allowed upon written approval of Owner's Site Representative. They shall not be set up under powerlines or pipeways (see "Permit to Locate Temporary Structures", Section 10).

23. RADIATION

.1 Owner's Site Representative must be notified prior to any radiological work.

24. BLASTING - EXPLOSIVES

.1 Explosive materials and devices must not be brought onto Owner's property or used without written permission of the project leader (see "Blasting Permit", Section 10).

25. PENALTIES

.1 If you do not conform to these rules, you will be subject to reprimands which may include Owner directing Contractor to dismiss you.

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